Cassell's Workshop Series

MOTOR-BODY BUILDING

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MOTOR-BODY BUILDING

BY

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EDITOR'S PREFACE

The author of this essentially practical book on motor-body building is himself a motor-body builder's designer and draughtsman who has achieved marked success in his work. He shows in these pages how to design a body on up-to-date and comfortable lines to fit any chassis in hand. He elaborates all the necessary detail with painstaking care, explains the operations thoroughly, and incidentally teaches the draughtsmanship of the body-builder's craft. He devotes a great deal of attention to fittings which now play so large a part in ensuring convenience and comfort, and not only to the fittings as such but to their working and their attachment to the body—points which are rather ignored in the very scanty literature relating to this craft. He devotes attention to the selection of timber for the different parts of the body, and does not forget the tools and machinery used in the body-building shop. It is believed that this book will be of great service to the master-man, the foreman, the craftsman, the apprentice and the student.

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Motor-body Building

CHAPTER I

The Chassis, and How it Affects Body Design

THIS book gives a close insight into the methods of designing and building motor-car bodies, but it will be evident that it is impossible to deal in a book of convenient size with every design and type to be found at the present day. Certain outstanding principles are repeated in every motor-car body, and it should be explained here that particular pains have been taken in the early chapters to show in complete detail the design and construction of one of the most popular body types and then, in later chapters, to describe the features peculiar to other designs.

Drawing naturally enters largely into body designing, and the reader must be assumed to have some slight acquaintance with the draughtsman's art ("Mechanical Drawing," a companion volume, deals fully with the subject). A special point, however, will be made of describing and explaining body-makers' patterns, their types and construction, with hints on their use.

A Three-quarter Landaulette Body.—The type of body selected as an example for general treatment is the ¾-landaulette, this being, perhaps, the most common type of body, next, of course, to the large class of open touring bodies. Its design also embraces to a very large extent

all problems and details of construction which are applicable to every other type.

No attempt is made in these pages to deal with the repetition or mass-production type of body. In application, the theory of mass production provides for one master mind among a thousand men, and essentially stipulates that the other nine hundred and ninety-nine shall be flesh and blood machines, with no call of any kind made on their individual knowledge and efficiency. The soul of the work, if it may be so designated, is sacrificed. It is sincerely to be hoped that all who read this book will derive some pleasure and profit, and that it may awaken a keen sense of the possibilities of their work and lead to a full and definite understanding of the why and wherefore of every operation.

It will be readily granted by all that to do the best work necessitates the ability to read a drawing; to read a drawing calls most definitely for one thing—there are others, of course—and that is, to be able to make one. It is desirable that the old rule-of-thumb methods, which while not by any means universal are very prevalent, should be disregarded entirely. A knowledge of drawing and its application simplifies matters very considerably, but whilst impressing the advantages of a knowledge of drawing upon the reader, it must be understood that it is not with a view to making draughtsmen of them all.

The aim has been to provide a general outline which will show the reason of certain practices which ordinarily are passed by as being done because it is the usual custom and without any real regard for the why and the wherefore of the operation.

The Chassis.—It may be common knowledge to most that the details of the chassis come to the motor-body

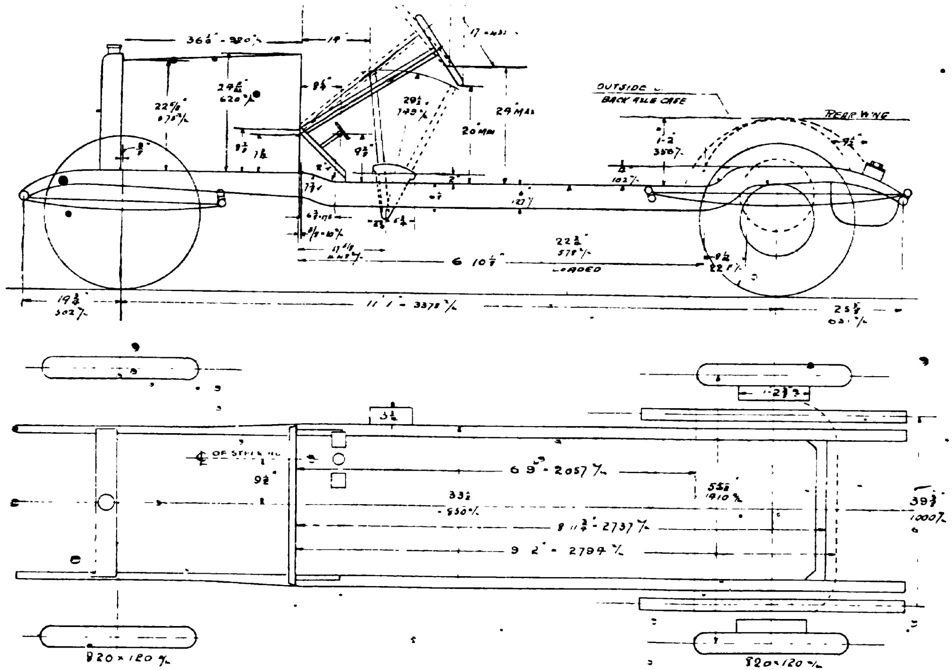


Fig. 1.—Typical Body-builder's Arrangement Drawing.

builder in the form of a mechanically produced print, either a blue print—white lines and details on a blue ground—or as a black and white print—black lines on a white ground. The type does not matter at all. In neither case may the print be scaled, as the process of printing distorts the paper. In its wet state it may have stretched, or it may have shrunk in drying, so the instructions generally given on the prints may be emphasised—they must not be scaled.

The name given to these prints is "body-builders' arrangement," or some term which means the same thing. All vital points are indexed, giving dimensions either in English figures or in the metric system, or in some cases in both. A reproduction of a chassis print, showing the elevation and plan, is given by Fig. 1, and this gives dimensions in both systems. It may be pointed out that the metric system is being used by British chassis makers to an increasing extent.

The conversion of metric to English measurements is easy if a rule is used on which both systems are given. Both measurements start from the same end, and a careful reading of the dimension, marking same with the thumbnail and turning the rule over, will give the exact equivalent in English. It should, perhaps, be pointed out that the general acknowledgment of 25 mm. being equivalent to 1 in. is not safe for working to, particularly for large measurements, and the only exact way is to make the conversion by means of a rule or a steel tape. A fairly accurate method of converting metric to English is as follows: Have to hand a rule on which there is a section marked with the metric system and a part, or generally one side, divided into inches and tenths. On a plain piece of paper rule a line about a foot long, read off

the dimension in question, say, 38.5 mm., take the metric side of the rule, mark 38½ mm. on it, then measure the number of tenths by the other side of the rule. Having marked off the dimension one-tenth full size, the English measurement in inches is obtained by reckoning the number of one-tenth spaces necessary to reach the same points on the lines. This system is accurate to within a quarter of an inch over any dimension, and the margin of error, or possible error, does not increase with the larger dimensions. It is satisfactory in every way for scale drawings, but if a full-size drawing is being made it is much better to use the rule or tape aforementioned.

It sometimes happens that, instead of having a print of the chassis in question, the chassis is available. In this case the chassis must be carefully measured up and a rough sketch made on which to put the figures. The need for accuracy hardly calls for comment.

If careful note is made of the order in which the chassis is drawn from the print, and a regular system is followed in taking down the dimensions, it will simplify matters in every way, and ensure that every necessary measurement is taken.

The first thing in making a scale drawing is to get the correct position, so that the drawing will come in the centre of the paper; this, of course, may be done by reckoning that the overall height is so much, and taking this from the depth of paper halve the remainder. The first line—that is, the ground line—is then drawn near the bottom of the paper. The wheel base, which is the distance from centre to centre of wheels, is then taken and, after the space necessary is determined at each end, is very carefully marked in. It may be pointed out here that the rule should be held with the marks touching the paper,

being tilted up at the back for this purpose if absolute accuracy is to be got. The possible error which may follow an attempt at marking off a measurement with the actual marks on the rule—say, $\frac{1}{8}$ in. off the paper—cannot be risked.

Another point of great importance is that all measurements be marked off on a right line—lengths on a horizontal line, depths on a vertical line. The attempt at guessing whether the rule is square with the line from which a dimension is taken may be more or less inaccurate, and is really a longer operation than doing things correctly.

Having measured in the wheel base, the wheels are next put in, at the present only giving the extreme dimensions of same, as they are all that matter so far as the body drawing goes. The next line to put in is the frame line, this being the top of the frame, as the depth of the frame never enters into the calculations as an important item. Whatever the shape is it must be reproduced with accuracy. The rise at the back and front of the chassis (Fig. 1) are put in with the compasses, and the lines on which the centres for the arcs are situated are given in figures, the distance being from the datum line.

The datum line is generally the inside of the dash, and from there all other dimensions count. Having got in the frame line the position of the dash is next found. On some chassis it is given from one point—say, the wheel centre, for instance—on others it is given in some other way. On the chassis illustrated it is given from the front of the rear wheel. To take the measurement, a vertical line just touching the front of the wheel and going upwards to the frame line is drawn, and then measurements forward for the dash are made. Having found the position, a perpendicular is erected on the frame.

The modern stream line bodies call for very particular attention to the radiator and bonnet, and if they are not taken fully into account in drawing the body a line will be obtained which, if not glaringly bad, will not be perfect and after all a perfect whole is made up of perfect details.

The bonnet and radiator should, therefore, be drawn in now, each point being marked as before instructed on a sight line, and depths marked and joined up with the necessary lines on the vertical lines.

The next consideration is the question of the steering wheel, and this is of vital importance. Many of the present

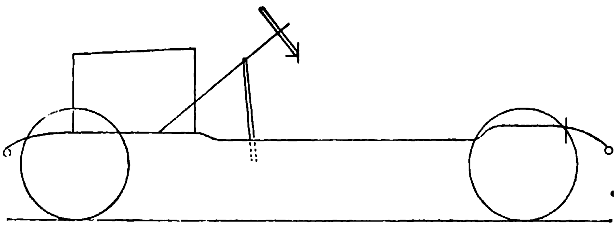


Fig. 2.—Chassis Drawing ready for Body Drawing.

day chassis have an adjustable steering column. It may be taken as a definite proposition that all closed bodies have the most upright steering columns and open bodies the most raked. Included with the latter are, of course the two-seaters and saloon bodies of various types.

It will be readily understood that in all closed bodies the interior is the part which calls for most attention. It must be as roomy as the chassis will allow. If the raked steering, as shown in Fig. 1, were used it would drive the front of the body back, shorten the interior and most likely spoil the balance of the body side. It is necessary to work on a sort of system of scientific art in designing bodies.

The maximum amount of comfort and room must be given and an article produced which looks well and evenly balanced. No single point must stand out by itself, and proportions must be nicely worked out, so that whatever the body may be, it looks symmetrical. It is also to be remembered that although the driver must have room to sit in comfort, still he must not have half an inch more than is necessary.

The two points in the drawing in of the steering wheel are distance behind the dash to the back edge of the wheel and the height from the frame of the underside of the wheel. For purposes of designing a body it is sufficient simply to mark the place with an angle; the drawing in of the wheel may be left to a later place in the scheme.

The position of the levers is the next consideration, and these dimensions can be readily traced on the print, the actual points of concern being the width over the quadrant and the width over the outside or brake lever and its most forward position. This will be dealt with more fully later, particularly in relation to the drawing of the plan, but it is necessary in the side elevation to know the height and forward position.

Having got these marked in accurately, there is only one more point of definite importance, and that is the clearance over the rear wheels. This is given very definitely on all prints. Account must, of course, be taken of the possible bump or give of the springs. If possible, the distance between the top of the axle case and the underside of the frame directly over same must be measured, and half an inch more clearance than this measurement gives be allowed. This system is not quite infallible, but where possible it may be taken as a guide, on the principle that

under extreme weight or bump the frame will touch the axle case before the wing or body touches the wheel.

On the chassis under consideration the necessary wing clearance is definitely given, and it is therefore marked in.

If the foregoing instructions are carefully followed the results will be as is shown in Fig. 2, the lines shown being all that are really necessary to enable a start to be made on the drawing of the body.

CHAPTER II

Designing a Landaulette Body Complete—A Comprehensive Example

An absolutely-rigid rule is that all the main constructional lines, whatever type of body is being drawn, are to be set out horizontally and vertically. The first of the vertical lines is the front of the main body, immediately behind the driver. As before mentioned, it is not necessary to give more room than is actually required behind the steering wheel. A luxurious seat may take two or three inches more than one which is comfortable, and the luxury is wanted inside.

The front of the front standing pillar is placed 19 in. behind the wheel, and this allows of a space 15 in. clear between the wheel and the squab, which is ample for the great majority of drivers. Average dimensions are allowed, unless accommodation for a very tall driver is being specifically arranged for, when special allowances must be made, but on no account must the interior suffer through too ample room being given on the front seat. The size of pillar given is such that the additions which are made, and which will be given in detail at a later stage, will make up the desired width or thickness.

The lock pillar may now be put in, and this again is governed by details which it is not convenient to describe in full at this stage, though it may be stated that experience proves that the most satisfactory dimension to show on the outside is 2¼ in.

The two references made to a later stage will come

up for close and careful attention when the drawing of the plan or cant board are under consideration, and it is felt that an attempt to explain it here will not be attended by the best results, as an effort is being made to take the student through the processes in a gradually extending scheme.

The next line to put in is that giving the width of the door. It is well in every case when designing a body on any chassis to find how the rear wing stands in relation to the body, for if the chassis is short it calls for careful attention, as the door must open over the wing without touching it at any place. The cutting-away of the rear side of the door bottom must be avoided wherever possible. A fair guide in a tight case is that the hind shut must not be farther back behind the vertical line put up from the wing, where it cuts into the line of the bottom of the body, than the amount of turn-under given to the body. This will ensure two things, that the door will not touch the wing when it is opened at right angles to the body, and also that it will be possible to get a curved corner which will join the pillar with the door bottom. The above points are vital.

In the present example, if the position on the lines laid down be tried, it will be found that a very wide door can be got, much wider, in fact, than needed and what will look proportionate. This being so it is possible to decide on the door width on independent lines.

A good roomy entry is given by a door which shows on the outside 28 in., and with a large body this is a suitable size. The distance should be marked on the chassis line, and perpendicular lines drawn through the four measurements.

The extreme rear of the frame must now be given

attention. It will be noticed that the actual body space indicated on the chassis print is 9 ft. 2 in. from the dash, and this measurement is marked in. To meet this line or point with the body, and to give a good, full, bold turn-under to the back of the body, it is necessary to go back 10 in. and draw another vertical line which will give the extreme back of the body.

The hinge pillars and back folding pillar may now be put in. The hinge pillars have nothing to interfere with their dimensions except that they must satisfactorily carry the hinges, and if these are butts, 1¾ in. will answer perfectly.

Regarding the back light, the present day practice is to make this of the largest possible dimensions, and it is necessary to consider what governs the length. The main thing is to consider what effect does the position of the pillar have on the appearance of the body when finished. If it is too far back, making the leather quarter too short, the tendency will be for the leather to drag and look flat instead of assuming a nice rich, full roundness which adds to the beauty of the work. The radius of the corners of most large bodies is about 9 in. Now, if the pillar is put there, the pull round the corner has the effect mentioned, so to prevent this it should be put at least 12 in. in front of the rear line; 14 in. is a little better, and, therefore, it should be marked in 14 in. from the back and the line drawn down. The last line in this series is the thickness of the back-falling pillar, which is 1¾ in. The front seat may be left for the moment.

Now a large body, to be proportionate and so designed as to balance nicely, must be of a fair depth. Bodies are not built so deep or high now as they were some years ago, and the tendency is to come down still more.

The first of the horizontal lines to put in is the elbow line. This is the line below the waist moulding. Where there are more than one, as in older types, it will be the one which forms the top of the panel, even if there is a decorative moulding below it. A fair average dimension above the frame line for this is 26 in. This line is carried right through from dash to back of body.

The next line is that under the cant rail. The cant rail is the top framing rail, and it comes immediately above the door top and runs right to the front of the driver's extension canopy. The next line gives the thickness of the cant rail, which is 1½ in., and this is the extreme height of the body at the side.

The top of the roof is the next in this series, with a rise in the centre which varies in different designs. In the present case, as it is a simple body, the rise will be only 3 in. The depth of the door top is now put in, and this is 1½ in., and next the depth of the waist rail, and although there is no rule as to what this shall be, leaving a bit of latitude for the designer, it may be shown as 5 in., which measurement is given from the elbow line.

The last of this series is the position of the shut at the door bottoms. If this is shown 1¾ in. deep this allows of ¼ in. bevel on the shut from the thickness of the bottom side, which is 2 in.

The spacing of the front seat may now be put in. A nice, long, bold scuttle dash is desirable; a convenient width for this chassis would be 13 in. There now remains only the width of the front door to show, and the skeleton or plotting lines are ready for the operation which calls for the artistic side of the draughtsman's work.

If the lines given so far are correctly drawn it will be found that the distance from the front shut of the front door

to the front shut of the main door is 38½ in. If this is exactly halved it will give the appearance of being too wide in relation to the seat side. The correct practice is to halve the measurement, then take ½ in. off, and that makes the door 1 in. narrower than the seat side. It will be noticed that this scheme provides a design in which the spaces from the dash are gradually increased in width, which gives an appearance of balance and symmetry otherwise missing if the points raised are not considered. The student will, if he has followed the foregoing instructions, now have a drawing such as is shown by Fig. 3, and will be ready to try his hand at shaping up the body on satisfactory lines.

The lines now to be put in are shown in Fig. 4, and the actual drawing of these is to the draughtsman's fancy as far as order goes.

A rule which is hard and fast is that wherever a curved line leaves the straight or a more moderately curved line, such as the side sweep or any other of the lines which may be called main pattern lines, it shall do so in an imperceptible manner. Strictly on the principle of tangential junction, nothing looks worse in a drawing or in a body when made than bad lines. A general rule is that the commencement of any deviation should be so imperceptible that it is practically impossible to tell, without very carefully looking into the matter, where the join is.

There is another rule, and this is that it is not an advantage to try and put in corners and curves with compasses, as even if well and carefully done they look hard and formal, and lack grace and beauty. It is granted that it is much easier to draw a series of curves parallel to one another with compasses, but even then the lines are bad.

Designing a Landaulette Body

In a later chapter a series of useful patterns will be shown which, though not intended to be copied slavishly, will serve as a guide to the student as to what sort of

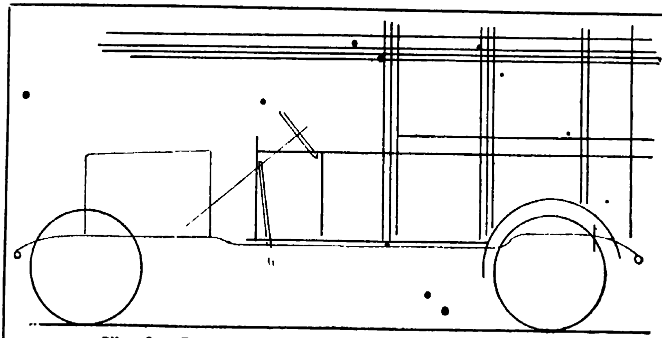


Fig. 3.—Showing Plotting Lines Set out on Chassis.

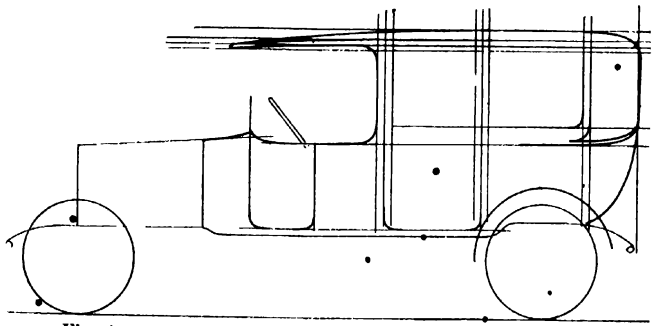


Fig. 4.—Lines Built up on Plotting Lines shown in Fig. 3.

patterns make the best job. All the lines should be drawn in freehand. The procedure is to design the lines and then make the patterns to line in with. Good patterns when made come in for many uses, and the general utility

of a pattern is a very good test of its good design. There is also the necessity of being able to copy a line at another scale when once it is agreed upon and made. The elbow line should start to rise very gradually at about the centre or a third of the width of the back light from the back. The point where the line reaches to on the back of the body should be about midway between the straight elbow line as first drawn and the extreme top of the back panel.

The height of the back panel is about 30 in. to 32 in. from the chassis frame; half this rise from the elbow line is shown on the side elevation. It will next be well to put in the width of the moulding. This shows 1 in. deep, and, as shown on the drawings, tapers to nothing at the back edge. The bead may be drawn in $\frac{1}{2}$ in. or $\frac{5}{8}$ in. wide; this also tapers to nothing, at any rate, on a scale drawing.

The back turn-under may now be put in; first of all give a sail back to the line of the head of $\frac{3}{4}$ in. or 1 in. and draw a straight line down from this point through the point where the back line and plotting line for the elbow cross each other. Now sketch in the back turn-under, gradually leaving the straight line at an increasing rate until the chassis line is reached at the point previously put in, about 14 in. behind the wheel centre, or, to be exact, 9 ft. 2 in. from the dash.

There is another point that calls for great care, and this is that the lines do not appear broken backed—that is, that having once left the plotting line they do not lose the gradually increasing reduction of the radius, if it may be so called.

The rear bottom corner of the back light should have a radius of about 4 in., a shorter curve being used on the pillar side than on the waist-rail portion. The bead must

come down the back edge of the pillar and then turn to join the elbow line bead. It should be drawn with an even increase in radius so as to leave the actual rail where it turns up with a surface increasing from about $1\frac{1}{4}$ in. to 4 in. Reference to Fig. 5 will make this clear.

The door bottoms may be drawn in after the lapping is drawn from the elbow line to the door bottom line, and across the door bottoms $\frac{5}{16}$ in. each side of the shut line already drawn.

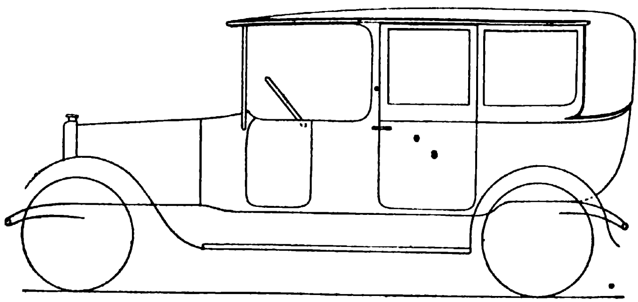


Fig. 5.—The Finished Drawing.

These corners should be of as small radius as possible, for there is really no beauty in a large corner, and its only justification is necessity in some cases. In relation to these points it is necessary to call in the illusionist's art to get the best results. The turn-under naturally foreshortens the vertical portion of these corners, so the curves are given a slightly longer side on these lines; the result looks almost geometrical in its accuracy, whereas it is only due to the comparison that they look alike.

Next, the curved lines joining the front pillar with the elbow line and the cant rail are put in; the short side of the curve is on the pillar at the bottom and on the cant

rail at the top. The line of the roof of the driver's extension canopy may now be put in; this is done to a line similar to the turn-under pattern, but much fainter; a true sweep would make a poor job of it.

The dash calls for attention next. The line of the bonnet is drawn past the dash line; a faint rise is given to this to provide sufficient height to carry the curve of the dash framing. The elbow line is then joined up with a curve which rapidly increases in radius.

Having got all these lines carefully drawn in and quite satisfactory, it will be well to clean the paper and line the job in, and the result will be a drawing something like Fig. 5.

Methods of Drawing Patterns.—Good patterns and sweeps are an indispensable accessory for the draughtsman and body-maker. The simplest are, of course, the sweeps, and these are made with so much rise, such as ½ in. in 6 ft. or more, as may be desired. To be truly useful they should be exact and capable of use at any point. They should also be an exact segment of a circle. Now the drawing of such a sweep for use on 1-in. scale drawings is very easy, as the trammels may be fitted with a long beam and so enable a perfect line to be struck, after which, of course, it must be accurately worked up. It will be readily understood that this method cannot apply to a full size sweep of the same proportions.

There are several ways of marking out a sweep to any radius, and some are of geometrical production. Perhaps the simplest and truest way is to get a piece of board double the length of the sweep required to be made, find the centre, and on the ends mark down double the amount of the compass required and plane off the edge to a perfectly true line from the centre point down to the above-men-

tioned marks. Having got this edge true, fix two nails in the board out of which it is intended to make the pattern, lay the sloped side of the board against the nails, then hold a pencil or scriber at the apex of the triangle and traverse the board from pin to pin. This, if done carefully, will give a perfect segment of a circle.

Another workman's patterns or sweeps should never be copied, for the best of men may make a mistake in making a sweep, and the copyist annexes faults and generally adds to them, and his faulty patterns are perhaps in turn copied by others. It needs no very vivid imagination to foresee trouble, or at the least spoilt timber, by the practice of copying instead of making the patterns in an intelligent manner.

The rams-horn sweep or curve is one which is of inestimable value to body-makers and draughtsmen. This is made by a semi-mechanical process. Having a suitable piece of wood, preferably ply-wood, the worker obtains also a reel, or a substitute for one, about 1½ in. in diameter. This is screwed to the board, say about 9 in. from one side and end. A length of string is secured to the reel with a loop at the loose end, and the string is wound up on the reel. A pencil or scriber is then inserted in the loop and the string unwound, when a gradually increasing curve is produced and one which is invaluable for both the draughtsman and the body-maker. It must be cut out accurately to ensure its being true. The great value of a true rams-horn sweep is that it enables a man to draw parallel curves to an infinite extent. If a rams-horn will not do this it is practically worthless. To add to the value of this pattern, it should be made a part of, or be fixed to, the best possible turn-under pattern.

A good turn-under pattern is a treasure. If a line can

be made for this which is of correct proportions, it may, when the rams-horn is already marked, be laid on to join correctly and marked in.

When good patterns are used very few are required, and the ingenuity and resource of the draughtsman will prompt addition to their number as necessity arises.

For irregular lines no definite method can be laid down. The best plan is to draw the line to scale, or, in other words, having need of a pattern the required line is drawn to scale and time is spent on it to get it right. Suppose it is the back turn-under; get the points to be joined, preferably at one-eighth scale, and draw till the line looks right. On this sketched line set out horizontal and vertical lines 2 in. apart, to scale, of course. Now get the piece of board out of which the pattern is to be made and mark it off in corresponding squares, decide upon the zero line both ways, and measure the points where the sketched line crosses the various lines, and transfer, as accurately as possible, to the full-size draught; sketch in a line joining up the points and cut out. Any slight irregularities which may be present in the working can be eliminated in planing and working up. The foregoing is the system to be employed in every case where a special line must be copied. It is practically the only way that a scale drawing can be faithfully copied. It may be well to point out that it is comparatively easy to draw a line on a scale drawing, but let the draughtsman try to produce a special line on a full sized drawing by the same method and the difficulty will be realised at once. An illustration will be given later in which this method is sketched out, so that the reader may see the exact application.

For all pencil drawings a very few patterns suffice, as it is possible to do any one line in bits, but for inking

in this is not satisfactory, so more elaborate patterns are necessary.

Now, in the general use of the rams-horn sweep a few words may be of value to the student, as its indiscriminate use leads to anything but satisfaction. It is necessary to consider optical illusion in drawing a body. Where a long line joins a shorter one at right angles the larger radius should be put on the long line. Door bottoms should have the larger radius up the pillar, the natural foreshortening of the line owing to its being on the turn-under will then give this line a perfect appearance. In general, lines curving up from the waist rail will call for the larger radius on the horizontal line. Pillar tops, where a corner is put in, will have it on the pillar. It is suggested that the student try both ways and note the results. It must be borne in mind that no line will stand indiscriminate or thoughtless workmanship.

A type of pattern which is very useful indeed is that giving a return sweep or ogee; the rams-horn and turn-under pattern will not, in many instances, give just the line, and so it is well to have special patterns.

Materials for Patterns.—For making full-sized patterns, mahogany or clean, dry deal or whitewood are suitable materials; for the rams-horn 3-ply is better than anything, being not so liable to get broken. For all scale drawings thick celluloid is to be preferred over anything else. It is clean, easy to cut, easy to work with owing to its transparency, and it has one inestimable advantage—it is constant, for it neither swells nor shrinks under trying conditions. The material must be thick enough to carry a fair bevel on the edges for inking in, as if the edges touch the paper the handling will make them liable to draw the ink out of the pen and cause a blot which will perhaps spoil

the drawing. On good paper a blot can be erased, but their avoidance is preferable.

The Plan or Cant Board. — The most important subject in coach drawing and building, whether applied to horse-drawn vehicles or motor vehicles, is undoubtedly the cant board. In days gone by this was a sealed book to very many well-informed and good workmen. The cant board was drawn in secret and misguiding details were inserted, and in general the real details were most jealously guarded.

There are several systems in vogue, the names of which are the three-foot line system, the five-foot line system, or the chassis line system. On the cant board every section is shown and also the contour of the body inside and out, and with a carefully drawn plan it would be possible for two men to each build half a body and their halves would go together accurately.

The three-foot line system cuts out an imaginary slice 3 ft. wide right down the body length—that is, 18 in. each side of the centre line. A glance at a body will prove to anyone that all the actual work lies outside this line.

In drawing-in the plan, as shown in Fig. 6, all pillar lines with any others which may be necessary are carried down the paper below the ground line, as drawn.

To show the seating a half-plan view is given, but, as above mentioned, the essence of the thing lies outside the 3 ft. line which is shown plainly in this view.

It will be well for the student to get the wheels drawn in, taking the dimensions carefully from the print, also the plan of the bonnet. A few years ago, before the advent of the flush-sided streamline bodies, body-builders had no concern in front of the dash line, but now it is neces-

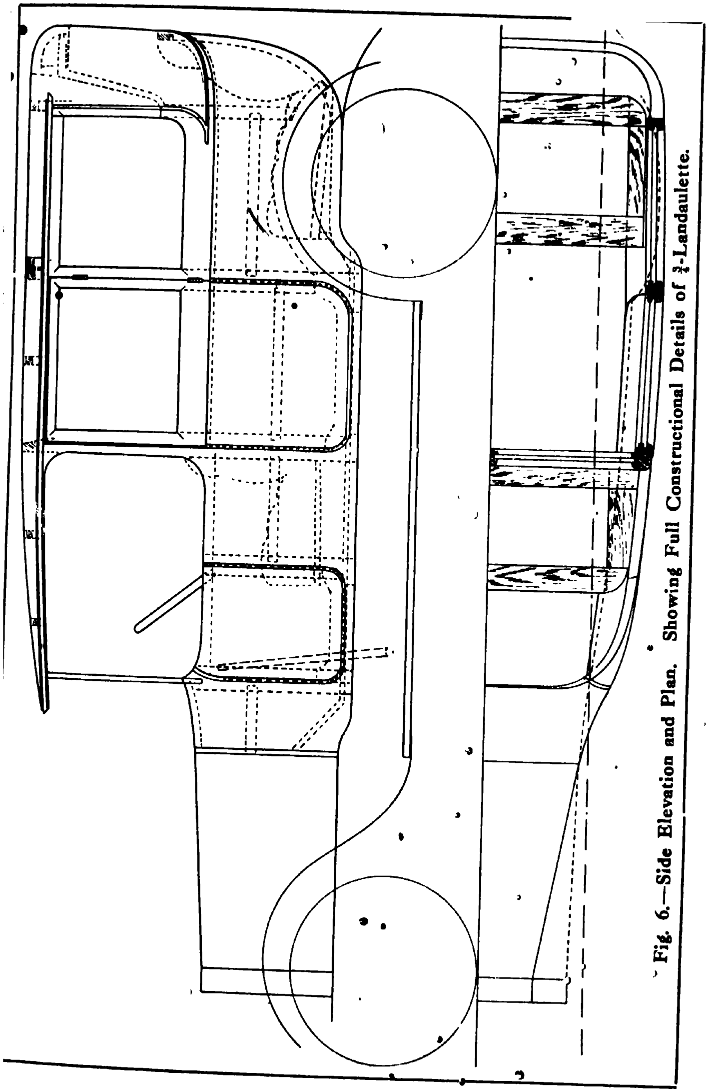


Fig. 6.—Side Elevation and Plan. Showing Full Constructional Details of ¾-Landaulette.

sary to take very careful note of the bonnet and radiator dimensions so as to enable the best results to be obtained.

It may be stated as a fact, and left to the observation of the workman to prove it, that most bodies for any size chassis need to be of a width at the widest point equal to, or slightly in excess of, the width of the track to give the necessary width on the rear seat for the right load. Large bodies are almost invariably made to carry three persons in more or less comfort on that seat. Fifteen inches per person is the minimum on any inside seat, 16 in. is better, and 16½ in. or 17 in. provides real comfort. In estimating widths it is necessary to take into account not only the seating room, but also the space taken up by the body structure. Roughly, this is 3 in. each side. The widest point of a body must, it will be agreed on considering the foregoing remarks, be at the rear seat. If the body is made practically parallel in that section from the rear door shut and the back falling pillar, and use is made of a moderate sweep for the side, it will invariably be found that the body comes correct with great ease and simplicity. A side sweep having a compass of ½ in. or ¾ in. in 6 ft. is quite quick enough, and it will be well, having got to this stage, if a sweep is made as directed in an earlier page. It should be noted that although 6 ft. is given as a hint of the length on which to measure the compass, that to be really useful the sweep should be 7 ft. or 8 ft. long, and it must be accurate. It may be here mentioned that the readiest way to test a sweep for accuracy, either scale or full size, is to lay it on a board, carefully draw a line along its full length, and then travel the pattern along the line backwards and forwards; if it touches the line in all positions it is correct. Reverse the pattern and repeat for

further test. If it meets these tests satisfactorily then the pattern is worth looking after and may be used with absolute confidence.

Now, in planning the side sweep of a body, there are, after the width at the seat is decided upon, three points which call for record and careful attention. These are the levers, the actual dash width and the width over the radiator. If the radiator is of an uneven shape, take the width at the side hinge; if definitely angular at the top, take the width at the angle. Draw a line from the bonnet to the dash and carry it back past the dash. Get in the position of the brake lever both in the longitudinal and transverse position, mark the positions accurately in the same way as the position of the steering wheel is marked. Next mark the necessary hand clearance for the brake lever, say 2 in. outside the lever. The point is now obtained round which the body must go. With bodies of the ordinary type, landaulettes, etc., and touring bodies, all that it is now necessary to consider is the thickness of the body framing, and this may be about 1½ in.

The side sweep from the front edge of the front seat to the back can now be put in. The front edge of the front seat side is mentioned, as it is more convenient, and generally quite satisfactory, to work from that point, giving all contraction or return in front of it. It will easily be seen that it is simpler to build a body which is true to a definite turn-under up to that position. In front of this it is necessary to work in the lines to meet the dash and bonnet lines. There are now two lines in the plan which are to be joined together to make a continuous one from the radiator to the back of the body. The connecting line must be as easy and graceful as possible in its curves. The continuation of the body sweep

contracts and the bonnet line expands, meeting in an ogee line as convenient. This line may be put in with a turn-under pattern, almost invariably the same as that used for the side and back turn-under. The bottom line of the body may now be put in.

The amount of the turn-under given may vary according to the taste of the designer, with this reservation: it should not be so extreme as was common at one time. The writer finds that 5½ in. gives by far the best results, less gives a poor, flat appearance, and more looks too round. In addition to this, exaggerated turn-under calls for larger timbers and, furthermore, is weaker; also it encroaches on the floor space unduly. There is another point against an exaggerated turn-under, and this is that there may be difficulties in getting the front windows down; further, it may be remarked that with frameless glasses in a straight fixed run, it is necessary to take care that the glass can be properly housed when down without touching the panel. The writer has seen, in the days of big turn-under and when bodies were built almost entirely of wood, instances of the bottom corner of the front window breaking through the pillar. Having given a reason for the turn-under decided upon, the distance from the outside sweep is marked in at right angles to it, but not on the pillar lines; use the same sweep for marking it in and carry it well forward.

The bottom line of the bonnet should be put in to give the line to work to and join up to. It will be seen that the return sweep necessary to do this is very faint compared to the other on the elbow line; in fact, it is almost imperceptible.

The remarks regarding tangential junction and easy, unbroken lines apply here with the same force, and any

suspicion of an awkward angular join should be avoided; and if one pattern will not do the trick another should be tried, or one be specially made. A glance at the two lines made will show how the turn-under is gradually lost and the turn-over made forward from the front edge of the driver's seat. The actual line of the widest point will follow a line bearing downwards from the seat edge to the chassis dash. At the hinge point, below this line or imaginary line, it is turn-under, and above it is turn-over, which gradually merges into the scuttle dash.

The actual drafting of a scuttle dash will be dealt with separately so that it may be shown on a larger scale.

For bodies having mouldings only on doors and quarter a line is now put in ¼ in. outside the main side sweep and perfectly parallel to it. It should be understood that the side sweep as originally drawn was on the panel line. The pillars, as previously instructed, have been brought down to the plan view. At the shuts and front of the back pillar the thickness of the pillars—3 in.—is marked; they may be used a trifle thinner, but it is a tight fit and may cause trouble. This 3 in. carries three things, the outer waist rail, the glass run and clearances, and the garnish rail.

Having marked the 3 in. spaces on all points mentioned they should be joined up in pairs, with a straight line—from front shut to back shut and then on to hind pillar. Now it will be noticed that the lines of pillar edges do not lie at right angles with the side sweep. This should be corrected next; a small square should be laid on the lines last drawn, touching the point where the pillar lines cut the side sweep, and the lines drawn in square to the inside straight lines. It will be seen that the results

vary, in some cases a little is added to the pillar, in others a little is taken off.

This squaring up is not absolutely imperative when frameless glasses are used in a straight run; that is, where they do not allow for lifting the bottom of the glass over a fence plate on the waist rail, but in all cases where framed glasses are used or the glass does go over the fence plate it is imperative.

The movement of the glass calls for a perfectly rectangular space in which to work, and a glance at the plan shown by Fig. 6 will illustrate the point under discussion.

This also shows the latitude which it is possible to give or work to for straight-run frameless glasses. It also shows the fact that the face of the pillar and the runs which are boxed out to take the channels, and which must of necessity be dead square with the face of the pillar, do not upset the lie of the glass to any extent. The small set which they have off the square is allowed for by the fact that the felt which is fixed in the channels will give sufficiently to allow the glass to slide easily, even with a slight tendency to nip on diagonal corners in each channel. It is, by the way, much easier to work up the pillars, neglecting the squaring up to the inside line. It is hoped that the foregoing remarks are plain and that it will be understood that the latitude there mentioned is permissible and that the reasons for this are clear.

No intention is entertained to prescribe for "slop work," but where a satisfactory result may be achieved at a cheaper rate it is advisable to work on that line. As the next item, the details of the pillar tops, as shown in Fig. 6, may be put in. Mark in the thickness of the waist rails on each pillar—both door pillars and quarter light pillars. These rails are perfectly straight on the inside,

following the side sweep on the outside. On the present body the door is to be hung on the hind pillar, butt hinges being used.

The shuts can next be drawn in. To strike the bevel of the lock pillar mark a point on the shut line which will represent the centre of the hinge pin, take the compasses, and with that point as a centre and with the actual door width as a radius, strike an arc from the outer edge of the body (as shown in the plan) inwards to where the line is crossed, which indicates the bottom of the body as already drawn in; measure the distance from the square shut line to the arc on the bottom side sweep, and then mark off a point rather more than half the distance. It will be found that the distance is about $\frac{3}{4}$ in.; mark about $\frac{1}{2}$ in. from the shut line on the inside of the pillars and join up with a faint line. Next put in the check, which is $\frac{5}{16}$ in. or $\frac{3}{8}$ in. as may be decided, and draw a line parallel to the one already in right across the lock pillar. This latter line will represent by far the greater portion of the door edge.

The position of the check is governed by the width of the flap of the door lapping, and this is $\frac{7}{8}$ in., so from the main side-sweep line, not the waist-rail line, mark $\frac{7}{8}$ in. and draw a short line to show the check; then line in the $\frac{7}{8}$-in. piece and the other $2\frac{1}{8}$-in. length and the actual check line. Mark in off the front pillar $\frac{1}{8}$ in. for clearance, and the result is the two pillars as they actually are at the top of the waist rail, and where, by the way, the pillars are actually 3 in. thick.

The hinge pillar is left quite square across the body; that is, if a straight-edge be laid across the body it will touch the pillars most of their width. On this shut it is only necessary to make the check and give no bevel. It

may not be necessary to explain why bevel is given, but it may be pointed out that if the lock pillar were square it would be impossible to open the door, as immediately it started to move it would trap itself; the line of outer edge of shut will prove this.

The position of the check on the hinge pillars is the same as on the lock pillars for the same reason.

The back of the rear pillar, that behind the quarter light, must be square across, as the fixing of hinges on a pillar which is other than square would be well-nigh impossible.

It will be remembered that the front standing pillar was drawn 2 in. wide on the outside; to this is now added the amount of bevel cut off the lock pillar, and also the amount of check given; this makes the pillar nearly 3 in. thick on the inside edge of the body at the line on which the section is shown. This allows for the front rail, glass runs and garnish rail. These must be the same dimensions as for the sides, but it is possible to work the front rail lighter at the top by shaping it into the line shown where the pillar joins the front seat side, and on which the trimming may well be placed and finished off.

It is a decided advantage, with the large wide bodies now being made, to make the front light in two panes. A glass about 4 ft. long and near 2 ft. deep is heavy, in fact too heavy to be easily lifted up, particularly as it is necessary to have such a large glass $\frac{1}{4}$ in. thick. By dividing the light several advantages are secured, amongst which are lightness and a lesser liability to break. Glass $\frac{3}{16}$ in. thick will do quite well with the smaller windows.

The front pillar need only be large enough to carry two glass runs, and may be got out of 2-in. stuff, allowing it to come to what it will when cleaned up.

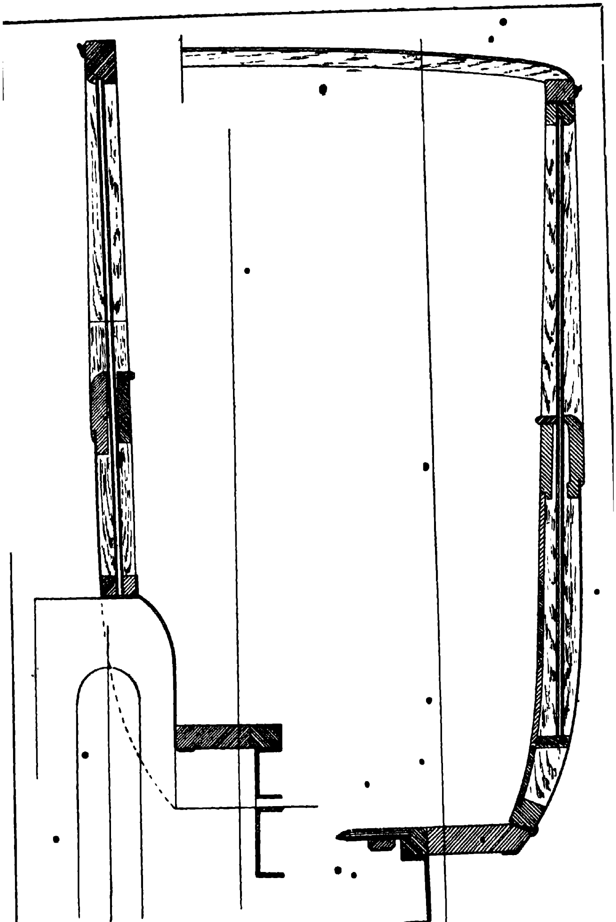


Fig. 8.—Section of Fig. 6 at Wheel Centre.

Fig. 7.—Section of Through Door, Fig. 6.

The pillar pattern shown in Fig. 8 gives all details of construction of the pillar and also the shape it takes from top to bottom. It may be well to draw this to double the scale to which the body has been drawn.

The illustration (Fig. 6) has been drawn to $\frac{1}{8}$ scale and the pillar has been drawn to $\frac{1}{4}$ scale. This is a good general rule to work on, as it will be found that for intricate, careful details accuracy is easier with the larger scale.

On one of the sectional views (Fig. 7) the full turn-under is given, in the other (Fig. 8) the section is at the wheel centre; they may both be worked out on one, but for clearness both are shown.

In landaulettes, perhaps more than any other type of body, the effect, if the pillars are put up perfectly square, is that the top of the body appears to contract, which is purely an optical illusion, though it must be allowed for. To compensate for this effect and give an appearance of squareness a $\frac{1}{4}$ in. of sail is given to the pillars above the elbow line.

It should have been mentioned that the most convenient method to adopt when drawing these sections is the 3-ft. line system, and to the student this has the advantage of adding to his practice in working to measurements on this system. Another point is that it is seldom that a half section can be accommodated on the sheet of paper in use. The measurement should be taken on the line where the section is desired and the dimensions transferred to the sectional drawing.

In the present example the turn-under is to be $5\frac{1}{2}$ in., so this can be put in by measuring from the square line from the elbow line to the frame line. The waist rail will be put in, and at the top of this the thickness—3 in.—should be shown. The pillar-top dimension is less, being

generally 2¼ in. Draw a straight line to show the inside edge of the pillar as far as it will go, and then, after marking-in on the rocker line the 2 in. thickness at the bottom, join the straight line to this point with a part of the turn-under pattern which best suits. The general outline of the pillar pattern is now complete, and the production of this full size follows the same procedure absolutely.

The glass run or groove for the glass channel should next be drawn in. At the top of the pillar this comes to a point ¾ in. from the outside of the pillar and cuts through the waist-rail line immediately inside the inner face of the waist rail proper, and is then continued down the pillar. It will be noticed that with the present design there is plenty of room for the glass to go right down, but this is not the case in many bodies, and a test should be made to see that there is room or that allowance can be made.

To test the run (in this case the glasses will not go over the fence, being fixed in a channel at the bottom to which the glass string is attached) the actual depth of the window space is taken and, say, 1 in. added for the bottom channel and ⅜ in. for the glass that goes up into the door top; and this is measured down the run from the top of the waist rail. If the bottom end of the glass does not come too near the outer edge of the pillar all is well, but if it does it calls for a little adjustment, such as reducing the space from the glass to the outer edge of the pillar at the top, or increasing, very slightly only, the distance from the outside of the waist rail to the glass run; this will throw the glass run inwards at the bottom and give all that is required.

Whilst dealing with the question of glass runs, in a general way it will be well to test the front standing pillar for the front glasses. If the body is shallow and

the windows are deep, there may possibly be trouble through the bottom corner of the glass cutting through the pillar, especially if the turn-under is by any means extreme. It may be pointed out that the dimensions given in the present example do not entail chances in this respect, but it is always well to try the point for safety's sake. The trouble is more likely to happen with cabriolets, as in these bodies the front pillars fall across the body and then lie practically level with the side waist rails; the front glass is consequently about 3 in. deeper than the sides and the rail is about 3 in. lower. This is a very fine point and will be illustrated when the drawing of a ¾-cabriolet is shown.

The quarter lights on a landaulette need not be seriously considered, as they may, and nearly always do, stand above the waist rail.

In deciding the position of the back pillar hinge, the position of the top edge of the glass when down is found, and then if the cut is made the thickness of the pillar below this the glass and pillar will be in a line.

The Landaulette's Seating and Interior Arrangements.— As mentioned when the front line of the front standing pillar was considered, as little space as convenient behind the steering wheel was allowed to provide an average seat. The space allowed—19 in.—as previously stated, is ample for a standard body.

The average height for a cushion for closed bodies off the floor is 14 in. The old rule that there must be 8 in. clear space under the steering wheel is not correct now, and many—in fact, most—of the chassis have the steering lower now than formerly. The most suitable height is as above stated, 14 in., and therefore a horizontal line at this height—that is, 16 in. above the chassis line—should be

put in. The backward position of the wheel is already drawn in; in front of this point measure 3 in., which gives the position of the front edge of the seat. Here the 14-in. depth is operative, but at the back of the seat an allowance of 2 in. below the horizontal line is made to give the slope of the top of the cushion. If allowance is made for a cushion 6 in. thick, which is a minimum, the seat board may be horizontal, the slope being provided in the cushion itself. Below this line is drawn the thickness of the seat framing, say 1 in., when, after putting in the front heel board, an idea of the space under the front seat for tools, etc., is obtained.

The position of the rear seat may now be considered, and this is found as follows: decide upon the space to be allotted to the back squab. This, including the framing, should not be less than 10 in. to 11 in.; measure this forward from the back line of the body and drop a perpendicular. The actual cushion width from front to back may vary from 20 in. to 23 in., but it may be averaged at 21½ in.; this measured in front of the last line put in indicates the position of the front edge of the seat. The height of the cushion here again should be 14 in. unless specially required deeper; this height should be put in horizontally back to the face of the squab line. This seat must be as comfortable as it can be made, and should have about 2½ in. slope at least.

The thickness of rear cushion should be as much as can be arranged for, so it is generally made about 9 in. deep at the front. The greater thickness allows of a certain amount of reduction in thickness at the rear edge, say 1½ in., which will leave 1 in. slope on the rear seat.

With the body on the chassis of the present example there is a 4-in. rise in the back of the frame; the back

framing is 1¾ in. deep, therefore the seat board is pitched up 1 in. at the front on a heel board.

The general intention in bodies of this type and size is to get three persons on the rear seat and two on folding seats in the centre or front of the body, and for this reason it is necessary to be a bit economical in space with the rear seat, although the latter must be *the* seat of the car.

There are many types of folding seats used in such bodies, some of which will be illustrated later.

Only two persons are provided for on the driving seat of any pleasure car, and the width provides ample room for these. The back seat, however, is nearly always required to carry three, with more or less comfort. The minimum width on the cushions to accommodate three persons is 45 in.—that is, 15 in. per person—but if 16 in. per person can be allowed it is better; 17 in. is still better, and wherever possible should be aimed at.

If the height of the cushion be transferred to the pillar pattern, the measurement may be taken of what width is allowed, inside the boards. The side squabs should not be thick, so as to allow the maximum on the cushion.

Whilst dealing with the rear seat, it is necessary to examine the extent to which the seat is encroached upon by the wheel arch and panel at the back of the wheel, from the arch framing to the bottom framing. The point really comes in for consideration when the section at the wheel centre is drawn, but it is advantageous to study it now.

The side clearance for the wheels should be ample in order to ensure the wheel clearing the panel when the body through any cause bumps and rolls; any rolling action will, of course, cause it to bump sideways. An allowance of 3 in. is suitable, and with a clearance of 2½ in. it is just safe. This is the amount given on bottom framing; from

there it rises vertically and then turns outwards by means of a beaten panel to the inner edge of the arch framing. The panel is of usual gauge sheet-steel and practically takes up no room. It is necessary that the panel should be well shaped over so as not to intrude upon the seating. The cushion is made to fit this closely, so that the width of the body on the cushion top is the greatest possible. A glance at the section on the wheel centre (Fig. 8) will fully illustrate this point, and if correctly drawn on the 3-ft. line dimensions it can be accurately read off at any point. In designing bodies this detail comes in for very early consideration so as to reveal just what can be done and so that matters can be arranged accordingly.

The operation is as follows: Draw in at the rear of the scale drawing a line to be used either as a centre line or a 3-ft. line; then off the print take the necessary width measurement, carrying the heights across from the elevation. The necessary points are the width of chassis frame, which is drawn in as it is shown on the sectional views in Figs. 7 and 8, and the wheel track, which is the exact centre of the tyre; the thickness of the tyre is put in by striking a semicircle to touch the top of the tyre as transferred from the elevation.

It has been pointed out that with landaulettes and limousines the rear glass presents no trouble, and so it need not be considered at all, the body being made just as wide and deep to the top of the waist rail and in depth of glass as any individual case calls for.

A thorough grasp of the essential details is imperative, and it is recommended that the student makes a practice of working out the glass runs and checking the seating accommodation even where the results are a foregone conclusion. This will enable him to be fully prepared to deal

with awkward cases as they arise. The great thing is to master the details and keep on practising, as this drives home points which cannot be too firmly grasped.

Scuttle Dash and Front Doors of a Landaulette.—The next matter is the very intricate and difficult problem of the designing and the drawing of the stream-line scuttle dash and doors.

The general lines of the dash are already in the side elevation, and in the plan the side sweep is carried round the levers in accordance with the needs and requirements set out on the print, but this is not enough to give a correct insight into the framing-up of the dash and doors.

The dash will be found worked out in a fairly large scale in Fig. 9. It is to be assumed that there is room at the front of the side elevation to draw, if not a half section, at least a section on the 3-ft. line, both of which lines will be seen plainly marked on the drawing referred to. Reproduce the lines called for in half back elevation, with the addition of those definitely dealing with the front of the car, and particularly all data connected with the levers—the width, height, and general lie of the outer one and also the quadrant. The height at which the dash is drawn in must be carried across, as also must the height of the chassis dash. If possible, next put in the actual shape of the chassis dash to radii, which are generally provided. In the present instance the top of the dash is put in to a rather large radius and then joined up to the vertical lines of the sides with a small radius. The finding of the centre for the small radius is somewhat difficult, and if many drawings are required of this particular chassis it will pay to cut a small circle of celluloid with which to put it in. Draw a line right through the dash on shut line, carrying it right down across the plan view; this will give the

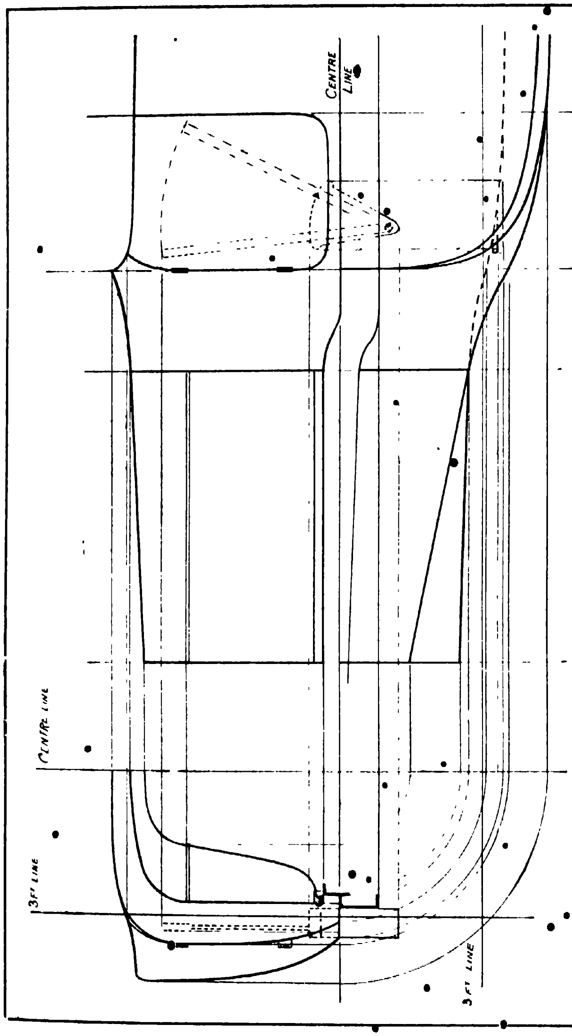


Fig. 9.—Showing Method of Working up Design for Scuttle-Dash and Doors.

widths at the actual point on which the section is being made. Mark in these widths on an extension of the chassis line, and erect a perpendicular at the point which corresponds with the greatest width of the body here. It will be well to give an example on this sectional view of the turn-under of the main body, as this will be of assistance in ensuring that the dash is being worked-up correctly. It must not be forgotten that the chief aim and object of this work is to ensure a nice clean job and one in which there are no distorted lines. The turn-under must be a part of the main turn-under so far as it goes, and in relation to the main body must develop a tapering appearance.

Referring back for a moment to the actual dash as it is drawn in, it must be pointed out that the top of the vertical line corresponds to the width on the elbow line, and from this point to the front of the seat side the elbow-line width turns down in a more or less regular line until it meets the corner of the dash at the point mentioned. This imaginary line is shown on the set of figures in Fig. 9.

Having put in a line which promises to be the right one up to the extreme width point, next sketch in the top of the scuttle dash. This line must be very faint in sweep, as the amount of rise above the top edge of the door is very small in relation to the width, and the idea is to get a line which gradually widens out in relation to the actual dash; having got, say, about 9 in. or 10 in. from the extreme outside, join up the top line with the side line already drawn in with a nice clean curve.

In Fig. 9 each point of importance is transferred from one plan view to front, elevation to plan, and elevation to front view by means of faint lines. To find any line or point on the front elevation it is only necessary to pro-

duce the lines to the centre line, and at the centre line of the plan and the centre line of the front view transfer the dimension with the compasses and carry it up to the line which is carried forward from the elevation. This scheme should be apparent, but if not understood a careful study of the drawing should prove ample to give a good insight into the matter.

It will be noticed that the plan shows the levers on the near side, this being done for convenience. The width necessary on one side must be matched on the other, and it is much more convenient to show a half plan with the ground line or any other convenient line as the centre or 3-ft. line; in the present drawing this readily enables widths to be transferred to the section.

The line shown in the sectional view of the back of the dash is an imaginary one, but the correct working-up of the dash necessitates this being put in, as to get the desired lines at the finish it is necessary to work to a straight cut section or imaginary section.

The top edge of the door must now be connected up to the top of the dash panel, as drawn in the elevation, and carried down to the plan. It is essential that sufficient radius be given to work it in with a nice unbroken line; too much must not be given, however, or the top front corner of the door will be too long, or overhang so much that it would make it impossible to enter the doorway. This point must be carefully studied both in the plan and elevation, and such a line be put in as will combine every point.

The top rail of the seat side is generally horizontal and merges into a vertical line, or one nearly vertical, on the actual dash; this calls for a tapered effect in the drawing as shown.

In the present design a rounded-over top edge to the panel is required, but this is obtained by working-up to an agreed shape, and need not be shown in this set of drawings. Sections or sizes of timber are purposely omitted, so that the actual idea underlying the scheme may be followed easily. It may be pointed out that any number of sections may be drawn in on the above system and any point checked to ensure a satisfactory result.

If the above system is employed on a full size drawing, as is essential in working-up a body on a strange chassis, the best system is to work as follows: Get in the side elevation, giving all essential chassis details as previously set out, then put in a 3-ft. line immediately below the elbow line, next transfer the chassis dimensions to this, work in the body round the levers, giving due clearance, and then proceed to put in the sections; a half section is the most useful, worked to the 3-ft. line. A good plan is to use the actual chassis dash for the centre line and draw the 3-ft. line to the left of it. In this case, of course, it is impossible to transfer dimensions in the manner already explained, but each one must be measured and put in from the 3-ft. line. In making a full-size drawing, it will be found to be a decided advantage to put in the elevation in black, the plan in blue, and all sections in red; this gives a clear illustration, easy to follow in every view, none of which intrudes upon the other. A careful use of this method is excellent for show or competition drawings, but it may be pointed out that it calls for judicious treatment to give best results. If the drawing is done in ink ordinary water colours are used, diluted so as to give the proper depth of colour, the pens being filled and used exactly as with ink.

For stream line bodies it is absolutely essential that the

bonnet line be put in for both plan and elevation. It will be very readily understood that to spring the dash line on an imaginary line may easily lead to a broken and bad line, and as endeavour should be directed to the production of perfect lines this matter must not be lost sight of.

The sectional views given by Figs. 7 and 8 may, and in many cases should, be put in on the full-size drawing—the main turn-under in the doorway and the section at the wheel centre with that line as the 3-ft. line.

CHAPTER III

Three-quarter Cabriolets—Some Special Points

In an earlier chapter it was pointed out that with landaulette bodies, as regards the rear window, there was plenty of scope, but with cabriolets this is not the case, and the problem of how to get the best all-round results is a very serious one. The great difficulty in the latter is the quarter-light. It is not possible to proceed exactly on the lines laid down for landaulettes—seat for driver, door, length of quarter are all the same; the total height will be about the same, but it is arrived at somewhat differently. With landaulettes lines straight from the elbow line to the line under the cant rail are required; here the clear height inside is decided, to this height add $1\frac{1}{4}$ in. for hoop stick, then the depth of compass and corners put in—usually 5 in. to 6 in., which gives the point under the cant rail.

As pointed out when the seat width of the landaulette was dealt with, most, if not all, of the large bodies call for seating for three persons with a total width on the cushion of 45 in. to 51 in. Now, as the track of large cars is 56 in., and the tyres measure $4\frac{3}{4}$ in. to $5\frac{1}{2}$ in. in diameter, it will be seen that the glass cannot go below the bottom of the wheel-arch framing. With modern practice there is another point which adds to the difficulty, and this is that the body must not be too deep from the frame line to the top of the waist rail.

A typical $\frac{3}{4}$-cabriolet is illustrated in Fig. 10, and the

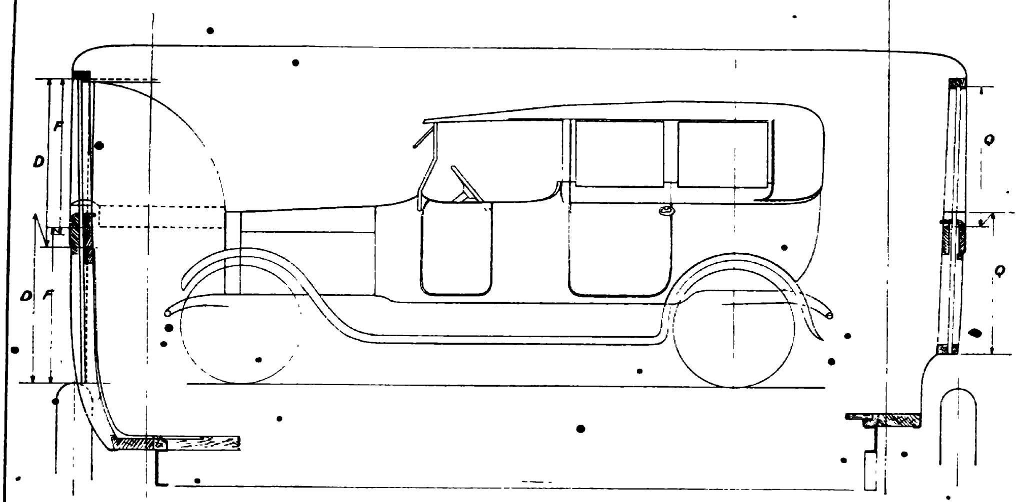


Fig. 10.—Design of ¾-Cabriolet showing Details of Glass Runs.
(*Complete scheme of details shown on sectional views.*)

details affecting the quarter-light are drawn in to a larger scale.

The quarter-light *must* go down level with the tops of the pillars to enable the head to fall with the pillar in a horizontal position, which is practically imperative for a smart appearance. Even if the head does not lie flat the front corner of the glass will, if it stands above the pillars at all, strike the pillar quite early, and the object, therefore, is to get the glass flush with the top of the pillars.

The spacing out of the depths of a cabriolet is very difficult; it is not possible to get a deep light by any means, and the problem really resolves itself into getting a set of dimensions which blend into a harmonious whole. Of course, if the light is made shallow, a deep, steep-looking side is the result, and if some of the depth in the head is worked off above the cant rail a heavy and antique appearance is the effect produced. In the drawing shown by Fig. 10 there is a light 18 in. deep. If frameless glasses are used, as in this instance, and these run in straight channels, there will be required practically 1 in. below the top of the waist rail to house the bottom channel on the glass, and ⅜ in. for the amount of glass which goes up into the groove in the cant rail. This makes the glass 19⅜ in. deep, and it must all go below the hinge centre of the main pillar. The position of the glass, up and down, is shown at the rear of the general body drawing (Fig. 10).

To assist in getting the glass away it is permissible to raise the hinge centre above the point which gives clearance for the pillar on the waist rail when down. The section (see Fig. 10) which is drawn at the line carried up through the wheel centre shows everything of vital importance at that point. It should be pointed out that

it is quite correct to cut a groove in the wheel arch framing-piece to allow the glass to go down right to the bottom.

Wheel clearances are worked out, showing the chassis maker's clearance over the top of the wheel and the requisite clearance behind the wheel to allow of roll and bump if these two occur at the same time. It is folly to restrict the clearances, as it must eventually lead to trouble.

The system in view when the design given was worked out was that frameless glasses would be used all round, and no lifting-over fence-plate and no carriers of the folding type used. A special device is to be used in which the glasses are fitted into channels which go up with the glass and supports it when up. To get the necessary stability for this a fair depth of glass is left in the run, 5 in. being shown on the drawing. This, of course, calls for care in planning the runs, so that they do not crop out through the pillar and touch the panel, and an additional 5 in. depth in the run is necessary, but with a moderate turn-under this is easily provided for, though the point must be considered every time. The door glass positions are shown, up and down, by the lines marked D in Fig. 10, the ends of which are linked together by a diagonal line.

The front glasses receive attention on the same section. The top of the front glass is level with the top of the side glasses, but as the front pillar must fall across the body behind the driver's seat it is necessary to make the window 3 in. deeper than the sides; this means that the bottom of the glass when down is 6 in. lower than the quarter-lights.

The matter that most calls for attention is that the glass must go down into the pillar without going through to the panel. The back of the channel is shown by a

dotted line from the cant rail down to the necessary depth (Fig. 10), and it will be noticed that it is quite correct in every detail. The up-and-down positions are shown by lines marked F in the section.

The front pillar is to fold across the front of the body, and there are two things to consider in relation to this, the position of the pillar hinge, which must be so placed that the lower end of the falling portion lies snugly up against the standing pillar, and that the pillar can, without strain, lie horizontally. Another point is to see that they will not touch in the middle. This is not very likely in modern bodies, as the depth is not too great for the width to accommodate it, but the point must be watched.

If a particularly neat, clean appearance is wanted, a short length of timber, shaped to match the pillar tops and fitted with pillar catches to go into the thimbles on the tops of the pillars, may be provided. This will give a right-through appearance to the pillars when down, and smarten the job up very materially. The fall of this pillar and its down position are shown in the section.

The plan is not shown in this case, as it will be generally on the lines of Fig. 6; the only point which should be noted particularly is that it is a decided advantage, in the interests of the folding head, to draw the body nearly parallel—inside, at any rate. The outside line shows a faint sweep, but the inside widths between the back and front pillars should be nearly the same, the back one, of course, being wider than the front; this, however, should not be carried too far or it will tend to upset the centres of fittings. The fittings for this body will be dealt with under a separate heading, and special reference will be then directed to all points of importance.

Three-quarter Cabriolets.

Before leaving this body it will be well to make a few remarks regarding the adjusting of glasses, their depth, and the quarter. If the general scheme has been set out, and the need arises for a bit of adjustment, the following rules apply. If the cant rail is lowered it reduces glass and the need for depth in the run by the same amount. If the waist rail is lowered it increases the glass by that amount and decreases the capacity of the runs by double the amount. If the cant rail is raised it increases the requirement for accommodation in the runs by the same amount. If the waist rail is raised it increases the accommodation, in effect, by double the amount to which it is raised.

It is permissible to leave the pillars standing a bit more above the waist rail to allow for a deeper glass, as this has the tendency to keep the side low and still have a fairly deep glass, but it must not be done to excess. It must be borne in mind that this body is used open and closed, and if the centres for head pillars are unduly high the appearance when the head is open is spoilt owing to the exaggerated depth.

The design of a three-quarter or saloon cabriolet calls for the most expert knowledge, and if the student can successfully grapple with all its intricacies he should be in a position to undertake any design which comes his way.

With reference to the width of the body, having got over the wheel, the limits are only those of requirements to be met in providing seating accommodation and keeping within reasonable limits over all. To be nicely balanced, and to sit well on the chassis, the overall width should not be greatly in excess of the track of the wheels.

CHAPTER IV

Limousines and Their Features

THE limousine type of body is, so far as working parts go, simple, but the possibility of working in graceful lines greatly exceeds that of any other body. The top being a fixture, it may be any shape, both in relation to the roof and lights, and it is possible to get a set of lines which may be extremely graceful. Several types are shown by Figs. 11 to 17. Fig. 11 gives the landaulette design adapted

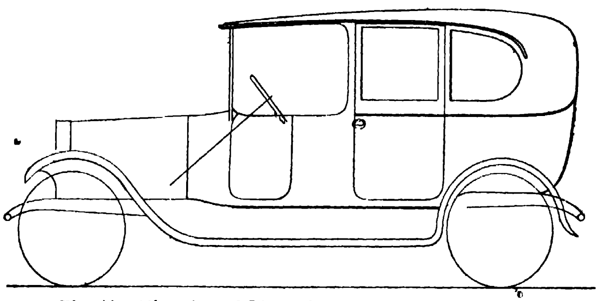


Fig. 11.—Elevation of Limousine with Dome-shaped Root.

to the limousine type. Below the elbow line they are identical, but the roof has a great deal more shape in it, both from front to back and from side to side. It may be said at once that primarily the roof and quarters of this body are a freehand job. The square lines are plotted as instructed for the landaulette (Fig. 3), and then the lines are sketched in, being altered and adjusted until the right line is arrived at, after which special patterns are

made. It may be pointed out that all the lines of the top of this drawing are put in with the same pattern.

The framing-up of a roof and back such as are here illustrated calls for the highest skill on the part of the body-maker, and the panel work is also of a very high class. The design shown by Fig. 11 is, as before stated, based on the ¾-landaulette, and is an exact replica up to the elbow line. The roof back and quarters are all in one piece of steel which reaches from door to door and from the lights down to the lower panel.

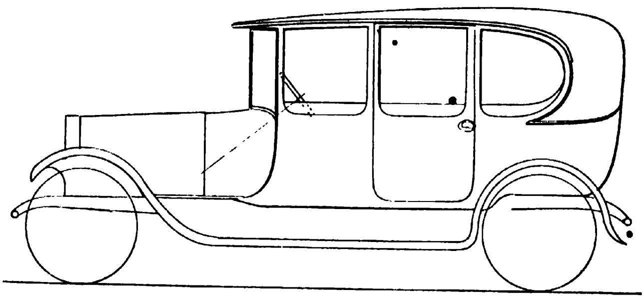


Fig. 12.—Elevation of Saloon Limousine.

The seating in this body is the same as the ¾-landaulette. The quarter-lights are either fixed or made to drop as may be required; naturally, the fixed windows are a bit cheaper to provide for, but the advantages accruing from those that fall, fully compensate for extra expense.

The saloon limousine (Fig. 12) is a body drawn generally on the lines of Fig. 11, but as the front seat may extend farther back than in the other type a more raked steering is used; also an adjustable seat is provided for the driver, a folding seat at the side of the driver, seating for three in comfort on the rear seat, and also two occa-

sional seats are fitted up in the centre of the body. Views of the seating of this body will be seen in Figs. 13 and 14, which may also be taken as typical of all full-size saloon

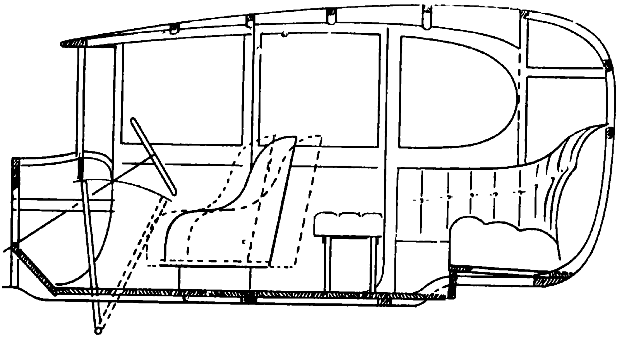


Fig. 13.—Longitudinal Section of Saloon Limousine showing Framing and Seating.

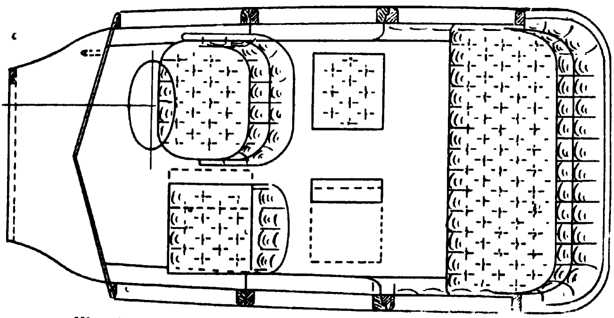


Fig. 14.—General Plan of 7-seater Saloon Limousine.

bodies. Naturally, if the chassis is small, seating for seven inside is not provided, but models for smaller chassis will be dealt with later. The range of designs for limousines is great, and several designs of recent types are shown by

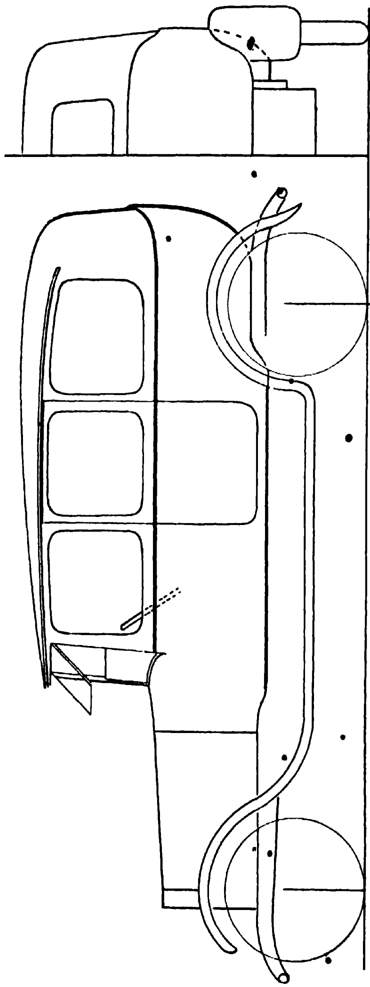


Fig. 15.—Side and Part Rear Elevations of Saloon Limousine with Contracted Top.

Figs. 11 to 17, all showing possible variations and more or less economy in production. The types shown by Figs. 11 and 12 are perhaps the most expensive it is possible to make, but at the same time they have a decidedly choice appearance.

One thing to be specially borne in mind, particularly in limousines, is that due care be taken to provide head *and* hat room over the rear seat; ladies' hats are of various sizes, and it is folly to provide head room which, whilst being suitable for a small hat, is unsuitable for one of

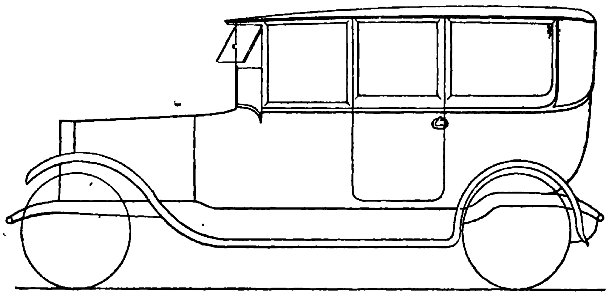


Fig. 16.—Elevation of Saloon Limousine of Cheaper Construction.

more ample proportions. Space must be economised inside, and, if the back of a body is very shallow, it means that, to give the head room, the back squab must be thicker than necessary to give the right clearance for the head and headgear.

The saloon shown by Fig. 12 may be reduced to suit a smaller chassis and be arranged to accommodate four persons only. It will naturally have to be reduced proportionately so that the balance may not be disturbed.

Fig. 15 shows a type of limousine body which seems to appeal to some people, though it is somewhat difficult

to decide what reasons prompt its design and production. The general rule is that the bottom of a body must be narrower than the top because the frame is contracted and because the shoulders of occupants require more room

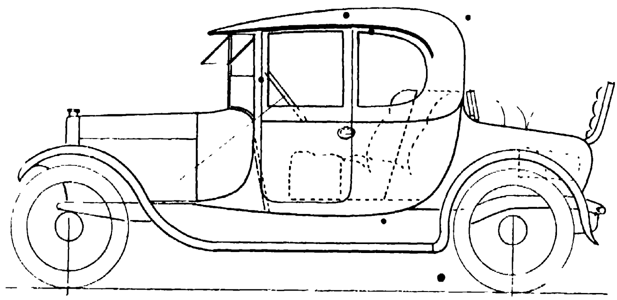


Fig 17.—Sectional Elevation of Coupé Limousine with Dickey Seats.

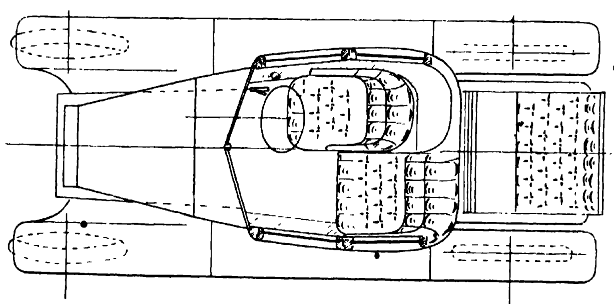


Fig. 18.—Plan showing Seating and General Lay-out of Coupé Limousine

than their legs. The windows lying on the slant appear to invite the entry of water to an undue extent.

The style illustrated by Fig. 16 is a somewhat simpler body to build than Figs. 11 and 12, and the style is applic-

able to both saloon and ordinary limousines. The roof and quarters of this type frequently are covered with leather. This helps in the matter of panel beating, and it is also an advantage in that a leather-covered roof does not drum like a boarded or steel panelled one does. If the engine is noisy, or insulation is bad, the fixed, drum-tight roof acts as a sounding board, magnifying the noises till they are practically unbearable. It may be suggested here that cork laid in between the hoop sticks will deaden the drumming, but it should be carefully fitted and securely fixed, and the efficiency is very doubtful.

With steel roofs, of course, it is best to insert battens alongside the hoop sticks, behind which, on the panel side, strips of felt are placed. It may also be suggested that all the noises heard in a roof are not necessarily the result of body-builders' faults.

A limousine coupé is shown in elevation and plan by Figs. 17 and 18; this is a somewhat rare type of body, but the illustration is given as typical, and the design makes for a smart body for a small chassis. The seating may be for three, but it is really better not to try to get a three-seater on a small chassis, as it throws it out of proportion, besides making it too wide for the chassis.

Radiators and bonnets in most cases are in proportion to the chassis as a whole, and to get a body even 45 in. wide on the cushion introduces difficulties in working in the dash.

A dickey seat may be fitted up at the rear, wide enough for two persons, but such is a decidedly unsociable arrangement.

CHAPTER V

Coupé Bodies

THE term coupé is applied to anything from a two-seater to a four- or five-seater. The majority even of the four- or five-seaters (see Figs. 19 and 20) are so designed as to come, if not quite clear of the wheel arch with the quarter glass, still clear enough to allow all the required latitude in this respect. The entry is almost invariably immediately behind the dash, a large door being fitted each side. A large quarter-light carries the body back to the head leather. The driver's sea' is usually made adjustable, in common with all inside-drive bodies, excepting only the smaller and cheaper two-seaters. The seat by the side of the driver must, to give access to the rear seats, be of a movable type. These particular seats, or some of them, will be illustrated later. The rear seat is made to carry three persons.

Tool and luggage accommodation is provided for at the rear. The fairly large box at the rear may well be partitioned off, giving a space for tools, and the top and back be made to open out to give a roomy space for luggage. The lid of the box may be made in two parts which fold together, and the back should fall like the tail-board of a lorry on hinges and retaining joints, thus making it very serviceable and with the added advantage of being available for small parcels without opening the tail-board. When not in use it closes up neatly and does not detract from the appearance of the car.

A raked steering suits this type of body better than a more upright one. The seats may be made to meet the

particular needs of a client without any question arising in the general design. The particular needs as regards screen and head fittings will be dealt with later. This body is being dealt with mainly as one with a head which

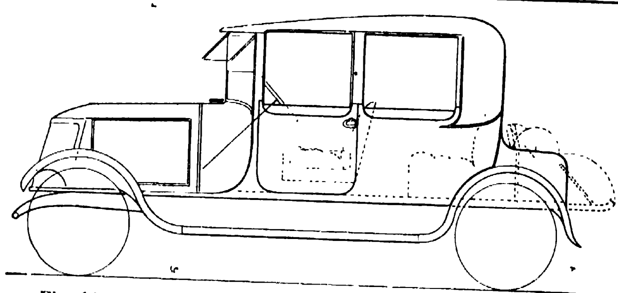


Fig. 19.—Sectional Elevation of 4/5-seater Coupé with Special Luggage Accommodation.

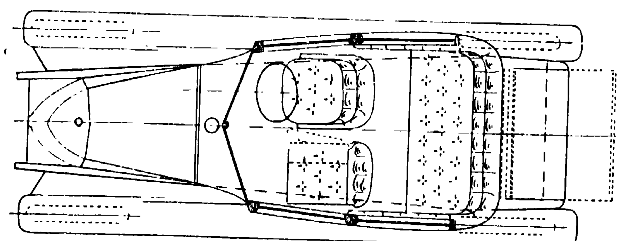


Fig. 20.—General Plan View of 4/5-seater Coupé.

opens, but the same dimensions and accommodation may be incorporated in a fixed-top body.

A somewhat novel type of body is illustrated by Figs. 21 and 22. This is a coupé with cloverleaf seating, suitable for a small chassis. Such a body provides excellent accommodation for three persons, all of whom have ample

leg and seat room, and, in addition, they are all close together and the space for parcels, spares, etc., is ample.

The rear seat can hardly be made large enough for two full-grown persons, chiefly because the leg room in

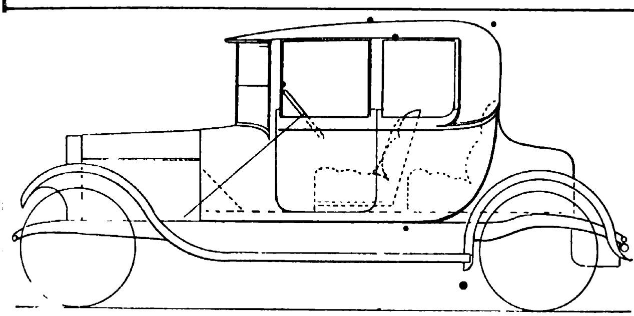


Fig. 21.—Sectional Elevation of Clover-leaf Type Coupé with Tool Box.

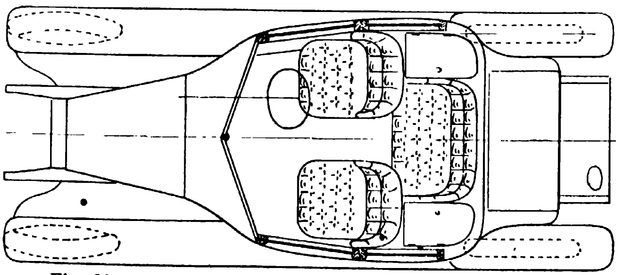


Fig. 22.—General Plan View of Clover-leaf Type Coupé.

width is small, but a really buxom person can sit in comfort, or two children as occasion demands. This body also may have a fixed top, but the majority of people prefer to have the air and an uninterrupted view, and if the weather is bad they have in the leather head

first-rate protection. There will be found on most chassis space for a tool-box at the rear, but on the chassis which this type of body would suit admirably it would not be wise to add a dickey seat.

The plain and simple two-seater coupé is shown in Figs. 23 and 24. This type of body is suitable for practically any chassis. The lights are no trouble at all, and the seating may be to general rules in relation to steering wheel or to individual requirements; also it is possible to provide an adjustable seat for the driver. The tool-box at the rear will, on most chassis, be found to come of ample proportions to carry a dickey seat, and the spare wheel or rim may be carried without much trouble.

This type of body may be fitted to any chassis, but it seems a pity to provide for inside seating for two only when the chassis is large enough to carry a seven-seater, though naturally all depends upon the requirements of any particular client.

To produce a nice, evenly-balanced two-seater on a large chassis it will be well to provide a good roomy locker behind the seat, with a lid or lids at the top. This will be found very attractive to most people, and is, in fact, a decided advantage. In fitting this box up it is well to carry it down only to the level of the front of the dickey seat or tool-box, whichever name is given to the back portion.

This arrangement gives ample room either for legs or luggage inside, and enables the seat in the dickey to be kept low without cramping the occupant's legs. It may be taken as a general rule that where leg room is short the seat must be high to help to carry off some of the length of leg; if there is ample room for the legs of the average person to go nearly straight the seat may be much

lower. This will enable the occupants of the rear outside seats to benefit from the protection of the lid which forms a backrest and carries the back squab. It may be pointed out that the back draught caused by the suction of a car's

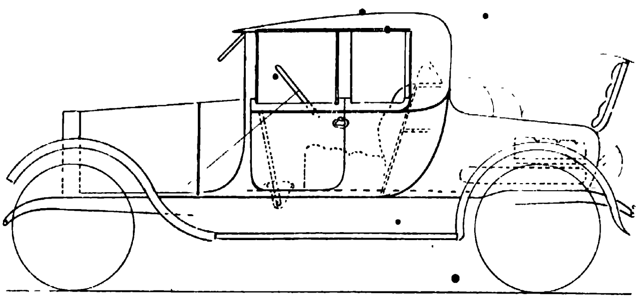


Fig. 23.—Sectional Elevation of 2/3-seater Coupé with Dickey and Wheel Space Inside.

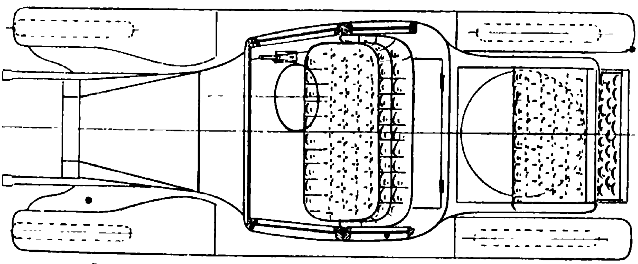


Fig. 24.—General Plan View of 2/3-seater Coupé.

progress through the air is very great, and except when riding against a stiff wind it is almost too severe to endure; therefore, if the passengers can be accommodated below the edge of the lid as above mentioned it will contribute very materially to their comfort. If it is possible

to get from 3 ft. 4 in. upwards from the face of the squab to the lining board which carries the squab inside the body, the cushion may be quite low, as in this case there will be plenty of leg room.

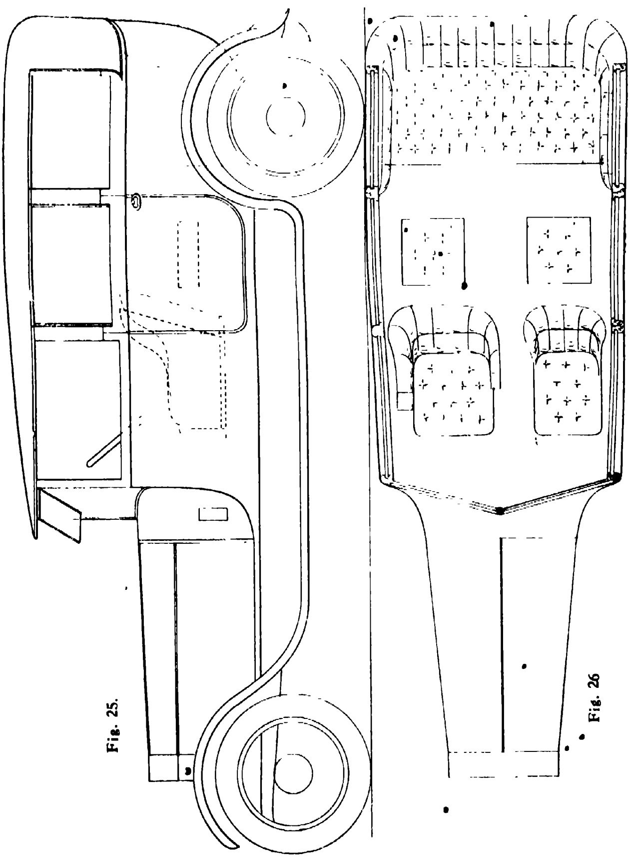
If accommodation for tools or the spare wheel or tyre is required in the rear of this body, they may be housed under the seat, which will, in this case, be made up on a board and be easily moved. The wheel, of course, should be kept as far back as possible and entry made for it from the rear through a small door. These points will be found illustrated in Figs. 23 and 24.

The contour of these bodies may be left to the client; it may be either a rectangular extension, giving a clear width of 36 in. inside, or it may be of an irregular shape, practically an extension of the main body side contracted from the main side sweep so as to just clear the rear wings, as illustrated in Figs. 21 and 22. This style gives a nice clean panel, and may be so arranged that the wing lies snugly against the side and excludes all dust and wet; also it provides a panel easy to keep clean, a matter which should be ever present in the designer's mind. All corners and awkward places should be eliminated, so that the labour of cleaning is reduced to a minimum. The vagaries of fashion cannot be accounted for, but it is hard to believe that the dirt traps which were so prevalent in old-type designs will ever come again. The square-tooled mouldings, stepped waist rails, and the plethora of moulding hung on the bodies were a nuisance and added hours of work to the task of cleaning—a task that is sufficiently unpleasant under the most favourable conditions.

The all-weather body, or saloon-cabriolet, almost deserves a chapter to itself. Figs. 25 and 26 show a typical body of this type, and it is pre-eminently the owner-

driver's body and for the man who has a family. On a full-size chassis with the full accommodation of seven seats, a really fine body can be got.

The question of quarter-lights, as was explained when



Figs. 25 and 26.—7-seater Saloon-cabriolet.

the ¾-cabriolet was dealt with, calls for exactly the same consideration. Unless the glass will go down *over* the wheel the body is to a large degree a failure, as three can only be accommodated on the rear seat with a squeeze. In addition, room for the other seats is cramped, and so the body is spoilt entirely from the point of view of efficiency. It will be found that if the width is restricted in keeping with getting the glasses down behind the wheel, the body will look sadly out of proportion. This practice should therefore be avoided.

The rear seat should carry three easily, and the driver's seat should be made to slide and be suitable for any possible occupant; the seat by the side of the driver may be either a fixture close up to the side of the body or be made to fold up against the driver's seat. Ample provision must be made to allow the driver and the occupant of the seat next to him to enter without crush or awkwardness. Both arrangements are illustrated in Figs. 25 and 26, and reference may also be made to Fig. 1 which gives the general lay-out.

The question of the centre seats is an awkward one, in that in most cases there is no convenient anchorage for them. With landaulettes or other bodies the extra seats may be more or less simple, but whatever kind are used there must be ample provision for attaching them either permanently or temporarily to the body, and in two positions if necessary.

In saloons the kind of seat shown in connection with Figs. 25 and 26 is used, and provides a comfortable seat which, when not in use, forms a table for use by those occupying the rear seats. The great drawbacks of many interior seats are the facts that they are not rigid and restful, and many of them call for quite an effort on the

part of the occupant to keep them in place. This point *must* receive very careful attention, and any seat which wobbles about or twists easily should be left severely alone. The seats are dealt with fully later, but it is very necessary to point out certain facts when dealing with the body. For all the interior drive bodies the most "raked" steering is preferable. The draughtsman has full scope for his lines on these bodies. He must so divide up the side of the body that there is either an equal width of glass for each light, or, if preferred, a proportionate increase as he goes back. Say, for instance, the front light is 24 in., the door may be 25 in. and the quarter 26 in., or they may each be 25 in., but the proportions should not be reversed.

It is almost imperative to quite miss the rear wings with the doors, and also care must be taken that the driver's seat does not obstruct the doorway unduly. In the design shown the fact that this is of the semi-bucket type gives a little latitude.

The door should be hung by its front edge on saloon and coupé bodies; for cabriolets, etc., this allows a larger centre pillar which, as will be seen when dealing with head fittings, is an advantage. The fact that the door is hung on the front will tend to cause it to shut if it happens to be open when the car starts.

The construction of all bodies is on similar lines, so it is not necessary to enter into details of the framing-up, etc., of this class in particular.

CHAPTER VI

Open Bodies—"Touring" Bodies

THE provision of seating accommodation in open bodies calls for the observation of the same principles as are required for closed bodies in a general way. In planning a touring body details of the chassis must be available exactly as for any other body. The steering will be raked for preference, and this should be drawn in and the seats plotted in the elevation on the same lines as for a landaulette body—19 in. behind the steering wheel for the front seat, which provides the position of the bottom of the seat. From that point put in, say, 5 in. or 6 in. sail, which will give room for the squab and give pitch to the squab; the seat is usually carried forward of the back position of the steering wheel 3 in. or 4 in., and then the height is gauged by the height of the wheel, allowing 6½ in. to 8 in. under it for clearance. The pitch of the cushion top should be drawn in, and this must be 10° to 15° more than a right angle for the lines—top of cushion and face of squab; the squab should be in a standard position, 15 in. from the wheel. If the seat is adjustable this measurement will apply to the central position or a trifle forward of the central position.

The seats may either be single or double, and be permanently fixed or be adjustable singly or together. If special comfort is aimed at they may with advantage be separate bucket-type seats and be independently adjustable.

The rear seats for a large body should accommodate

three in comfort, and this is easily managed if the plan as drawn for landaulettes is used. Extra seats may be fitted in large bodies; if they are included the front seats should be a fixture, and the folding occasional seats should be anchored at their rear. They may be arranged as sliding seats.

In spacing out the panels on a touring body it is necessary to use discretion. A nicely-balanced side should be the objective, and wherever possible it is well to get the rear door in just so as to clear the wing nicely and then divide up the side with panels which increase in width towards the rear. The side is then graded and looks even. If a wide door or doors are provided and a narrow seat side, the effect is not pleasing.

The shape may be anything from a top edge that is practically square, finished with or without moulding, to the roll-over top edge which gives an appearance like an egg with a side out. The front seat should be joined to the body by a continuation of the line right over the body. The back of the body may be in keeping with the sides, developing in some cases to a pronounced bulbous shape. Various types are illustrated by Figs. 27 to 29. Fig. 27 gives a simple type of fairly cheap construction and easy panelling.

Fig. 28 shows the roll-over side and bulbous back, and Fig. 29 shows an angular type of top edge which lends itself very well to some chassis but not at all to others. Each of these may be used for what may be termed standard work, and each may be varied to meet the demands of the "sporting" class by modifying the depth of the side. All these bodies, as stated above, are designed on the same system as closed bodies, but they are most decidedly more awkward to work up satisfac-

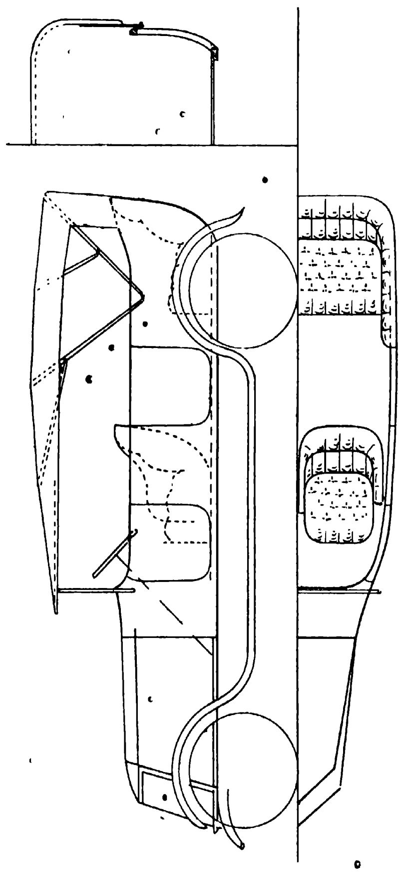


Fig. 27.—Sectional Elevation and Half Plan of 5-seater Touring Body.

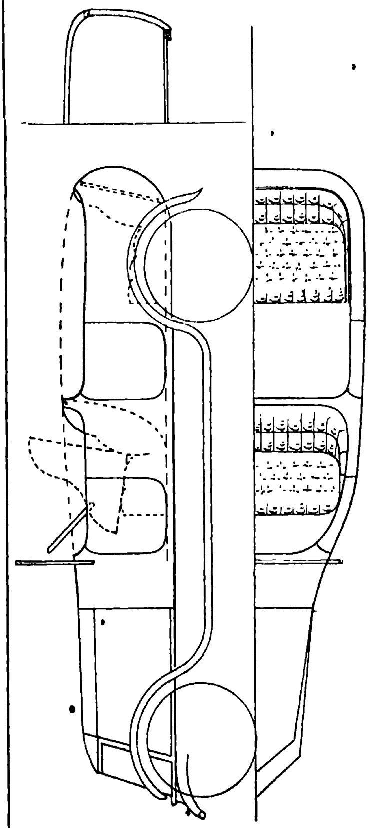


Fig. 28.—Sectional Elevation and Half Plan Bulbous Sporting 5-seater Body.

torily, and call for very careful work if a nice, clean, and graceful body is to be the result and if they are to be really comfortable.

It will be noticed in the drawings (Figs. 28 and 29) that the imaginary line showing the top of the body is put in; that is, the line that would fill in the top of the body and which is cut out in the contour of the side of an egg (fusiform).

A half section is shown in each case to more fully illustrate the actual side of three types of bodies; the top rail is shown as part of the con-

tinued line which is broken into to get the seating. The final edge is neatly rounded over towards the inside and the panel is fixed immediately on the edge. There is a strip boxed out of the top edge inside the panel line deep enough to carry the trimming materials, canvas, leather, including pleats, in some cases piping, and the finishing bead in all cases. This bead may be bright brass or nickel, or painted, in which case rough bead is used; it may also be covered in leather as used for the trimming.

The intention is for the top of the bead to come flush with the panel edge and make a neat, clean finish. Previously it was mentioned that the back squab should lie at an angle of 15° more than a right angle with the cushion top. To illustrate this, in Fig. 28 is shown an ordinary square board drawn in with dotted lines, which will make the point quite clear. Sometimes an exaggerated amount of pitch is given to a cushion and the back squab is at right angles to the top of the cushion. Really the fact is that an exaggerated pitch to a cushion calls for much more pitch over the square line than is necessary when the slope on the cushion is just sufficient to hold the passenger in comfort.

Figs. 30 to 32 show several examples of open two-seaters. Fig. 30 shows a clover-leaf three-seater on a small chassis, the general lines of which may be incorporated in bodies of other size, larger or smaller. The object is to get an oval or elliptical outline for the shell, both in elevation and plan, and adapt the general lines to suit. The widths and depths must be decided upon in connection with the chassis dimensions, and then a nice clean line set out from the dash, the line being worked from the radiator in both elevation and plan. This is absolutely imperative or the results will be unsatisfactory.

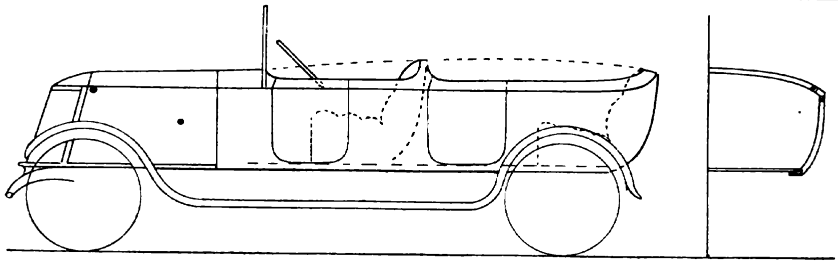


Fig. 29.—Sectional Elevation of Angular Type of 5-seater Touring Body.

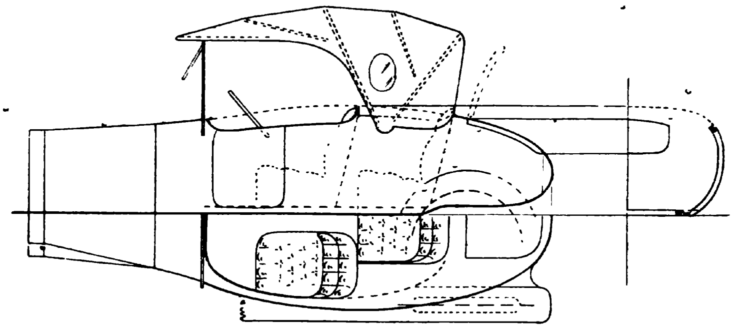


Fig. 30.—Sectional Elevation and Half Plan of Clover-leaf 3-seater, with Tool-box at Rear and Victoria-type Hood.

It must be borne in mind that where simple lines are being employed they must be good and true; there is a chance to hide poor lines where the whole is broken up into distinct parts, but in the case under discussion the line, both in elevation and plan, must be as near perfection as possible.

This type of body is pre-eminently a case in the first instance for freehand work, then for making a pattern or patterns to suit, and then, having got the right lines, of plotting the curves for reproduction full size. The lines are really such that it is very far from likely that stock patterns, even where the range is large and varied, will be found of any use, and frankly it may be said that any attempt to fudge the lines will lead to disappointment. A few projecting lines are put in, and they will sufficiently indicate the system which may be followed out to a much greater extent with profit to the designer and body-maker. In preparing a full-size working drawing of bodies such as this, it is imperative, if best results are to follow in a workmanlike manner, that sections be shown at points of importance—wherever any framing comes—so that these may be worked up correctly. This, of course, is easy to do on paper, but an attempt to do it when the building is going forward will cause endless trouble. A decent and true ram's-horn and a good turn-under pattern will enable the draughtsman to put in all sections correctly. It need hardly be said that the section lines must *appear* symmetrical.

In the drawings shown each has been made as simple and understandable as possible, and on this account many sections that could be introduced have been omitted, as if all were put in that are called for on a full-size drawing, the result would be a confused mass of lines.

The seating is for three, and the design allows for all being under cover during bad weather. The leg room for the centre passenger is perfect, and neither passenger is incommoded in the least by the others. To ensure proper seating for the two front passengers it may be advisable to give the cushions a slight downward pitch at the outside edge, as this tends to throw the occupant against the body side, making for greater comfort.

The locker space at the back is ample for petrol, oil, tools and small luggage, but is not intended for bulky

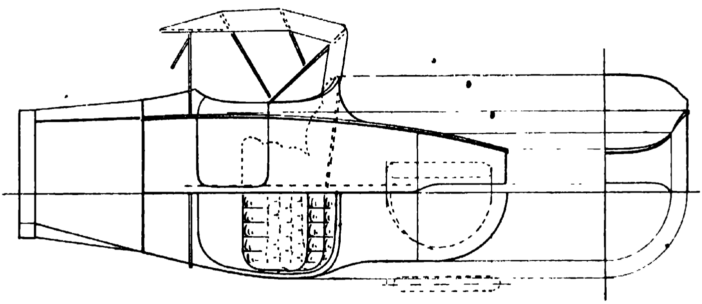


Fig. 31.—Sectional Elevations and Half Plan of Cheaper Type of 2-seater Touring Body designed to Eliminate Panel Beating.

packages. In addition, there are lockers at each side of the rear seat, which may have lids in the top or pocket flaps on the sides.

The victoria-pattern hood is shown, and lends itself very well to the body and general design; the fittings of this are of the "one man" type.

A very much cheaper type of body is shown by Fig. 31, and in the design of this the elimination of beaten panels has been kept in mind; it will be seen that behind the dash line, and excepting only the corners of the seat, there

is no beaten work at all! A much simpler top is shown; this would be metal to the first hinge, and behind that the construction would be of the solid-board type, the edges of the wooden lids being rounded over to match the half-

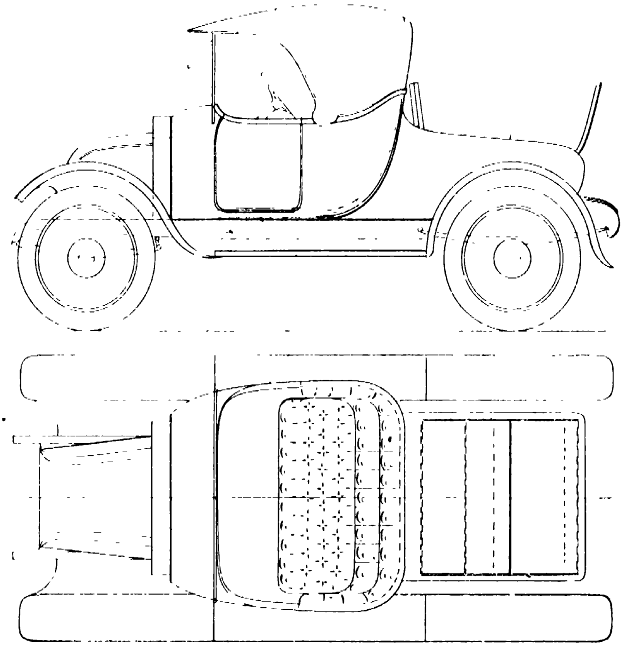


Fig. 32.—General Design for Two-seater.

round moulding on the seat sides, doors and dash. A cheaper fitting is also shown for the hood, the front extension being linked to shorten it, and the others simply falling together.

The seating is the ordinary style, providing room for

two in comfort. The lids may be used for luggage and a seat may be put inside over the wheel or tyre. Very few projecting lines are shown, this with a view to further insight into how the scheme works.

A two-seater of a more general type is illustrated by Fig. 32. The seating or general plan view is also shown, and reference to the coupé (Fig. 24) will illustrate these points as well. The rear seats in this design should, if possible, be kept inside as shown in Fig. 24, and the lids should be specially prepared for the accommodation of luggage.

The actual shapes that these bodies take is quite at the discretion of the customer or draughtsman, the chief concern of the latter being to make accommodation calculations and build the body to suit these requirements.

The scuttle dash may be built up on the lines set out in Fig. 9, which system is, of course, applicable to all bodies having an open driving seat. Consideration of a sketch on the lines of Fig. 9 will show the possibilities and requirements and enable the design to be commenced with confidence.

CHAPTER VII

Waist Rails of Closed Bodies

IN this chapter various methods of treating the waist rails of closed bodies will be shown. The older types of waist rails are shown in Fig. 33, and these are now practically obsolete, being shown as a matter of interest only and for

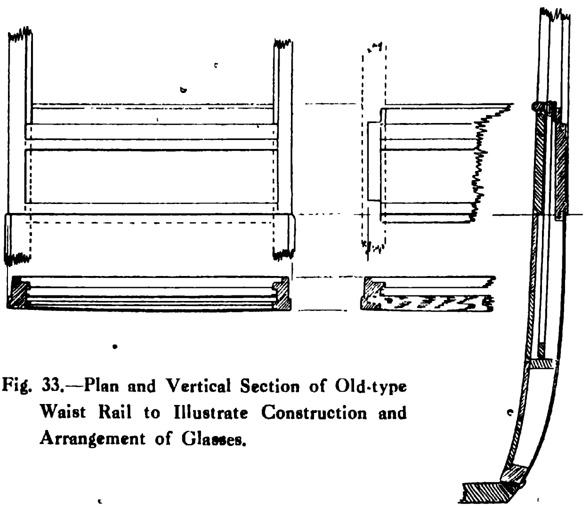


Fig. 33.—Plan and Vertical Section of Old-type Waist Rail to Illustrate Construction and Arrangement of Glasses.

comparison with modern practice. Many of them were like a miniature flight of steps, and generally were relics of the days of the landau and brougham. The cutting up of the rails into small strips had the effect of hiding the apparent depth of the waist rail and breaking up into a presentable appearance what would otherwise be a deep

slab of timber. Many of the older bodies were decidedly deep from floor to roof, and as the roofs were in the main rather flat, there was no help in that point towards carrying off any of the height. Then, as now, an attempt was made to balance the proportions as nicely as possible, and so there had to be a spacing-out to achieve this, which is not now necessary. In addition to the great depth of the bodies, there was often a very exaggerated turn-under given to them, and this, of course, prevented the use of deep lights, as even with the shaped runs then employed

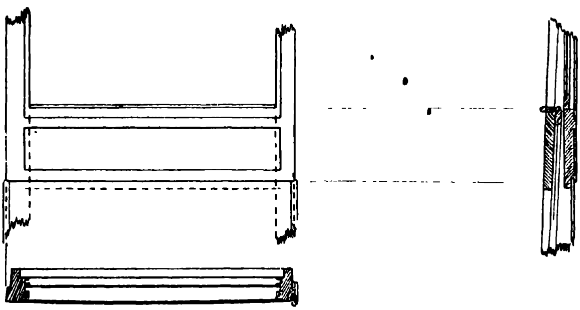


Fig. 34.—A Step in the Evolution of the Waist Rail.

it would be wellnigh impossible to get the glass down without the use of very big pillars; big pillars, besides being heavy and ugly, also reduce the inside widths, so they are to be avoided as much as possible.

The turn-under in old bodies was frequently 8 in. or 9 in., and, of course, affected the glass runs much earlier than in cases where the turn-under is, as is now commonly employed, 5 in. or 5½ in.

Fig. 33 shows a typical waist rail, common to both doors and quarter-lights. The framing-up of the door as a whole, and the waist rail in particular, is illustrated in

these drawings. The actual piece of timber is shown in various particulars in one or other of the details, also the joint used is shown and the method of arranging the outside joints so that they are kept as short and inconspicuous as possible. On the pillar pattern will be seen the glass runs above and below the top of the waist rail, with the fence plate used with framed glasses, and also some cases where frameless glasses are used. The method of framing the rail into the pillar by means of a stump tenon is also shown. Fig. 34 gives a very much modified type of Fig. 33, and only shows the waisting double the width on the

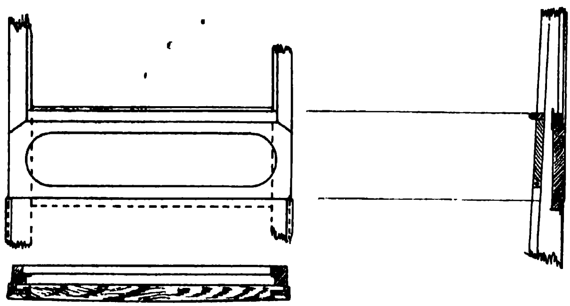


Fig. 35.—A Further Step towards Modern Practice in Waist Rail Construction.

rail that it is on the pillars. In this case the glass frame is shown up and down. The run and all other details will be exactly as in Fig. 33.

Fig. 35 shows what was at one time a very popular type of waist rail. The actual panel may have been either flat or rounded over as shown, but the great difficulty with this type was the hiding of joints on the outside or keeping them to the lowest limit. The rail may have been joined to pillars from the corner of the waisting in a diagonal line

to the full extent of the pillar or fitted up in the manner illustrated. This shows a very complicated joint indeed. It is stump-tenoned into the pillar and lapped on to the outside of the pillar, and the edge, to prevent the showing of end grain, is made with a mitre so cut that it comes exactly on the edge of the pillar. In addition, the top edge of the mitred joints shown would be dovetailed into the pillar; the plan view of this shows the working in section.

The next illustration (Fig. 36) shows a step in the evolution of the waist rail. In this it will be seen that

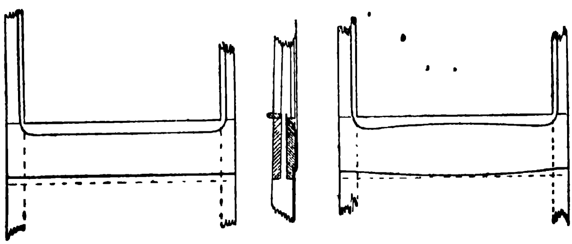


Fig. 36.—Design of Waist Rail showing Elimination of Superfluous Crevices.

the multiplicity of lines and edges is avoided, giving a simpler and cleaner job. This result was often achieved by means of a superimposed mahogany moulding which, of course, could be cut to any shape, as it frequently was, there being no reason for restricting this practice beyond ensuring that it came on timbers to which it could be fixed. This type of waist rail was first used with the earlier flush-sided bodies and is still good practice. Fig. 36 is given as typical only; the form the lines take is absolutely at the designer's discretion. The sectional view (Fig. 36), shown between the two types, is common to the

two designs. The actual joint on the pillar is also drawn in. Fig. 37 shows a solid rail with waisting; both the moulding and the edge of the waisting are rounded over to the largest radius possible, and, as indicated, they may be made either with square or round corners.

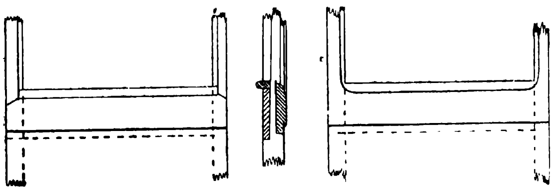


Fig. 37.—Designs of Solid Rails with Square and Round Corners.

Fig. 38 gives the first kind of pillar and rail where waisting is dispensed with altogether; they are both rounded over to the fullest radius possible, and the waist rail is carried right through to the edge of the pillar, the

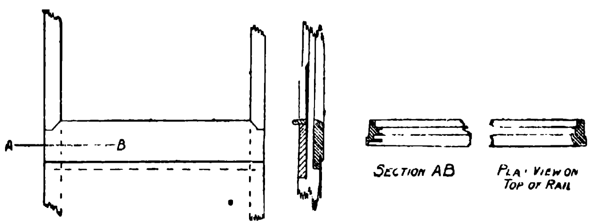


Fig. 38.—Pillar and Rail without Waisting.

mitred joint following the line indicated, and then the joint to a very small degree goes straight across the pillar; the short length of horizontal joint may with advantage be dovetailed into the pillar so as to prevent the edge rolling over and showing badly. The example is another case of the joint shown in Fig. 35 being used. The other plan-

section (Fig. 38) is shown to illustrate the pillar shape, which is the same as the top of the waist rail.

Fig. 39 shows a method of eliminating altogether the waist rail so far as it shows. The joint outside is mitred, but the rest may be either mortised-and-tenoned or lapped into the pillar. The steel panel is carried right up to the top edge next to the glass, the mitre joint is followed, and a very short length of horizontal joint line is left. The pillars may be steel cased, but it is hardly necessary if the timber is sound and dry.

A much cheaper way of finishing the rail is shown in Fig. 40. In this case the rail is rounded over to the desired

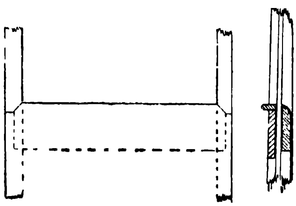


Fig. 39.—Waist Rail with Plain Lines.

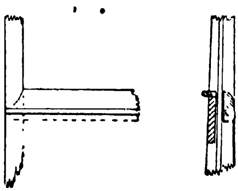


Fig. 40.—Another Plain Type, Eliminating Detail Panel Work.

shape. It is better to keep near the shape of the pillars, the width of these governing the radius. If the shape is like that shown the effect is really not so good. The panel is fitted to a line decided upon, and the edge and fixing screws are covered with half-round aluminium moulding of a suitable size, or it may be finished with an ordinary shanked bead.

This type and method allows of the bead following right round the back in the case of leather heads, and then the bead down the hind pillar will be neatly joined in by

cutting a long mitre joint, so as to give the appearance of both pieces springing out of the one.

Another method of treating the waist rail is shown in Fig. 41. In this case the panel is carried right over the lower rounding of the waist rail and the top is left in the wood uncovered. This method allows of the use of fairly

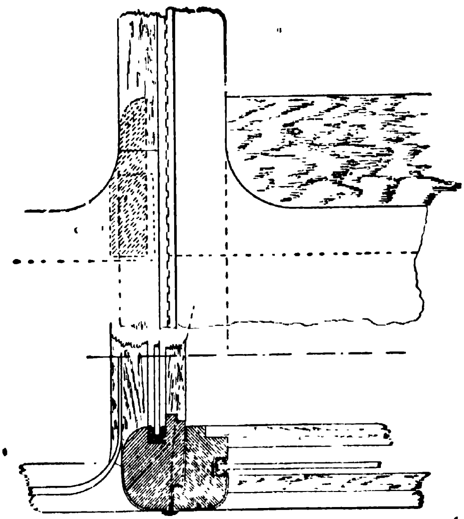


Fig. 41.—Elevation and Plan of Front-standing and Lock Pillars with Waist Rails, Garnish Rails and Glass Runs Illustrating Steel-panel Treatment of Covered Parts.

large radius corners in the design of the body and yet keeps the top clear for a straight line if desired, as is the case with cabriolet bodies.

The finishing of the panel on the actual pillars should be carried up past the joint of rail and pillars, and so counteract the tendency of the spring of the pillars to open the joint.

Whilst dealing with the question of joints on pillars, it may be well to mention two ways employed to preserve the appearance and prevent the actual joint showing unduly. In some cases a parting tool is used to **V** out the joint, leaving the actual line of the joint at the bottom of the **V** when cut. The other method is to fix short pieces of straw beads over the joints. Neither of these is handsome, as they look what they are—makeshifts, but they prevent the unsightly broken joints. Well-made joints, white-leaded together and securely fixed, if the timber is good and dry, will do very excellent service and keep in good condition. There are, however, two matters that militate against the joining of steel and wood, however well made the joints are and however securely the metal is screwed on, and these are heat and extreme dryness, especially heat. The latter, whilst tending to shrink the timber by super-drying, also causes the steel to expand, and the reverse actions will start any joint. All that can be done is to make sure that the timber is well protected against wet.

To overcome the possibility of the joint showing, at any rate on the outside, the panel may be carried right up the pillars, but this is a decidedly expensive business and not possible on all jobs. If it is, however, simply a question, as it sometimes is, of rolling over a piece of steel forming an extension of a piece which must be beaten, it is, of course, possible to do it quite easily, and it is well worth doing.

One thing must be borne very definitely in mind, and that is that all-steel covered parts, whether covered in whole or part, should be made of the driest possible timber for several reasons. One is that timber, as it shrinks in drying, will pull and buckle the steel; another

is that even if the panel is not buckled, the screws, which are mostly soldered up, on good jobs at any rate, will start the solder round the edges and show a break in the face which comes right through the paint; and the other, which is perhaps the most important, is the possibility, in fact almost the certainty, of the sweating of the framing setting up a sweating on the inside of the panel, which will very promptly come through in blisters and spread with great rapidity.

Before leaving the question of waist rails, it may be pointed out that to cheapen the design shown by Fig. 41 it is possible to finish the steel panel on the flat, or just before coming to the roll over, with a metal bead. This should, however, be kept to quite small limits, $\frac{3}{8}$ in. or $\frac{1}{2}$ in. at most, just enough to cover the very edge of the panel and as much as possible of the screw heads.

Fig. 41 is drawn to a larger scale so as to show certain important details which require very careful attention. The elevation (Fig. 41) shows the front standing pillar and the lock pillar with the waist rail shown as plainly as possible. It also shows the front rail of the body in dotted section. The pillars and rail are given in overall dimensions in dotted lines. The steel-covered parts are left plain in this and every other view and part of same, and it will be clear just where and how the steel goes. The panel is continued up over the first rounding and then up the pillar, being shaped to fit round the end of the top portion of the waist rail, which portion is left uncovered by the steel. The covering is fairly easy if the corners are made and welded in; the rest is nearly plain rolling, just a bit of hammering on the waist rail being required owing to the faint side sweep. The front standing pillar is covered over, or past, the joint on the pillar as indicated.

The uncovered parts are grained in the drawings so that they may be readily seen and understood.

The elevation is further explained by the sectional views, and these are directly in line with the elevation. Connecting lines are omitted purposely so that the drawings may be as plain as possible. The correct shape of the rail is shown, as is also the garnish rail. The finishing fillet is typical. In framing-in the garnish rail, due allowance must be made for the finishing fillet, which, when it is on, comes level with the top of the waist rail, or sometimes, with folding heads, a little under, to allow of the glass-string slides coming under their normal position.

The position of the glass channel is also shown. This frequently does not lie parallel with the inside of the waist rail, but this point is decided when the glass runs are set out; at any rate, the channel at the top must be quite close to the rail. The rail is hollowed out a bit to ensure clearance for the bottom channel on the glasses. The turn-over of the panel is shown clearly.

The plan (Fig. 41) shows a carefully drawn section of the pillars. The shut is struck out on approved lines. The hinge centre (butts being used) is put $\frac{3}{8}$ in. outside the panel line, there being no need to go the usual $\frac{5}{8}$ in, as there are no upstanding mouldings. With the hinge centre as the centre, and the width of the door as a radius, the arc, which will be seen cutting across the standing pillar and several inches inside, is struck to the line of the turn-under outside—that is, $5\frac{1}{2}$ in. from the outside line. A square line is carried up from the outside of the shut to the turn-under line, which line, by the way, is shown by dot-and-dash line. Measure the centre of the space between the square line and the arc, incline a trifle to the arc side of this, and then draw in a line connecting the

outside of the shut to the point just found. Mark off the check at a point $\frac{7}{8}$ in. from the outside and give the check $\frac{7}{16}$ in. and draw in a line parallel with the first put in. Now off each pillar mark $\frac{1}{16}$ in. for clearance, and draw the double line as indicated.

Another way of striking the bevel is to go across the pillar only, and at the point where the arc touches the inside add $\frac{1}{8}$ in. and draw in the bevel, continuing as above. It need hardly be pointed out that this operation is very vital. If insufficient bevel is given the door will not work properly, without easing off at any rate, and if too much is given the pillar will be cut away too much to accommodate the lock and handle properly.

We naturally get a decided advantage where the doors are wide, as the larger the radius the less it cuts in on the shuts; also doors of bodies which have a very pronounced side sweep are favoured, as the shuts being cut square with the outside the bevel is there automatically if the standing pillars are made to allow it. The dimension given above ($\frac{7}{8}$ in.) is arranged to provide for the screw-plate part of the **T**-shaped lapping. This is usually $\frac{7}{8}$ in. wide, and so the extreme edge of it forms the edge of the check.

The glasses and channels are shown in position both on the door and the front rail.

CHAPTER VIII

Seating and Leg Room in Design

FOR bodies of the landaulette type the steering is required in the most upright position. The arrangement of this detail is now fairly definitely decided by the chassis designer, and full consideration is given to the fact that for these bodies the room is wanted *inside*, the driver being allotted just enough room in which to sit in comfort and control the car with ease and safety. The seat must be fairly high to allow of this. A general rule is that the shorter the distance from seat to pedals the higher the seat must be (in reason, of course), the aim being to bring the legs of the driver into the position more nearly approaching a right angle than is the case when the seat is lower. As far as possible 8 in. clear should be given between the steering wheel and the cushion, although half an inch or an inch may prove of use in using up the leg length so that the driver is not cramped.

The length of leg, counting from the back to the heel, is about 3 ft. 6 in., varying, of course, with different individuals. On the chassis taken for the present example the distance from the dash to the steering wheel is $30\frac{3}{4}$ in., the position of the pedals is $9\frac{7}{8}$ in. from the frame to centre, and $8\frac{1}{2}$ in. from dash to centre; about 16 in. space is allowed behind the wheel when the squab is compressed, and a seat 15 in. high from the floor is provided, which is 2 in. above the frame line.

The front of the cushion will be 26 in. from the dash, leaving about 18 in. from the cushion line to the pedals.

Coming as it does about 3 in. in front of the back of the wheel, the actual cushion accommodation is 19 in., this space being very nearly horizontal. This gives an easy position and scope for the use of the rest of the leg length. Note should be made that on no account should the cushion, if the back is nearly vertical, be pitched down at the back, as the seat then would only be suitable for a short, hump-backed man. The length from the edge of the cushion with the pedals up is 20½ in. A direct line from the pedals over the edge of the cushion gives a length of 3 ft. 3 in. (cushion compressed), and this dimension will allow of free and efficient use of the feet on the pedals. With lower steering—"raked," as it is called—the dimensions are roughly the same, because the driver must be comfortably accommodated. Extra tall or extra short drivers must receive special attention.

The chassis of the present example has an adjustable steering which, in the raked position, gives 33 in. from the dash to the back of the wheel—2¼ in. farther back. This position also alters the clearance under the wheel, making it 20 in. above the frame—4 in. less than upright steering—which, of course, brings the cushion down about 4 in. There is not much necessity to bring the front of the cushion back to correspond with the more backward position of the wheel, though it may be done if required. Take as a radius the distance between the point of the front seat edge decided upon for the upright steering and the pedal centre, and mark in the lower seat line, then put in the distance from front to back of the cushion and draw in the seat back, giving on the face of the squab the same distance which was arrived at for the upright position.

It will be seen that this method gives corresponding room from the pedals to the back squab, but in a different

setting. The cushion may with every advantage be made with 2 in. or 2½ in. pitch, the back squab making an angle of at least 15° more than the right angle with the cushion top. This pitch of the cushion helps the legs of the driver to assume an easy attitude, and allows also for the thighs getting full support from the cushion.

The comfort to be got out of a cushion which really fits the driver, as compared with that in which the driver

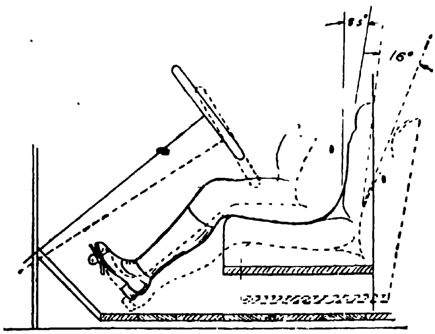


Fig. 42.—Diagram showing Positions of Seat for Various Types of Steering and illustrating the Need for a Recumbent Posture when the Seat is Low.

only gets the bottom of his back resting thereon is beyond description.

In setting out the interior seats of any type of body, the principle holds that if room is plentiful the seats *may* be low, allowing the occupants to loll and practically lie in them; but if body length be restricted the only way is to keep the seats as high as possible and have the backs fairly upright, always, of course, subject to the particular wishes of a client. In short bodies where extra seats are used it is necessary to keep them all fairly high, so that the seats and legs of occupants come very near the

right angle. A low seat in a small body is an abomination, as the knees of the occupants are forced up.

In Fig. 42 will be seen, roughly sketched out, a landaulette front seat; the chassis details are correctly drawn, and a typical position is set up for the driver, the landaulette being shown in every detail in clear lines. The dotted lines show the steering dropped down as far as possible. Exactly the same dimensioned driver is shown, and the matters discussed will be apparent on a brief study of the sketch. Relative positions in Fig. 42 are shown in dotted lines. Particular attention is drawn to the angle of the back squab in relation to the cushion; the degree of pitch which should be taken as a guide is that shown. It may vary slightly according to individual taste and requirements, but the limits are rather small; too little is out of the question, and if too much is given it will cause the driver to sit too far back to reach the levers easily.

Generally speaking, in relation to drivers' seats in saloon or open bodies—that is, touring bodies where the seats are disposed usually as in saloons—the driving seat can be made adjustable, and then the right shape having been provided for the cushion and squab, the seat may be moved to suit the very tall or the very short driver.

If the few remarks made a little earlier in this chapter are followed carefully there should be little difficulty in setting out the seats of an interior. Always remember that pitch of cushion calls for slope of squab, and as these are increased they call for more room from front to back and indirectly for a bit more in width, as the occupants, lying well back in a well-pitched seat, tend to claim more elbow room.

The actual width of cushion from squab to front edge should be for a standard body 22 in. clear; short persons

may want it narrower and tall people wider; the great point to aim at in this respect is to give a cushion that the user may feel at the calf of the leg, and at the same time enables him to get the benefit from the squab. These last few remarks are merging very closely on trimming, but they directly concern the draughtsman, as the designer must put in the seats. It is vitally important that the body-maker should know just where the seats must go both for height and width. Nothing should be done by way of experiment, which entails subsequent alterations. In nearly every body the question of tool disposal comes very definitely to the front, and space under the seats provides valuable room, if it can be secured, as it may be by a careful disposition of the seats and cushions.

CHAPTER IX

Timbers Used in Body Building—Some Practical Considerations

Choice of Timber.—Speaking generally, the question of timber for body building is exactly as it was in the days of horse-drawn carriages. Then as now *the* timber par excellence for body framing was English ash. Best English ash, well prepared and carefully cut, is second to none, being really ideal for the purpose.

Ash has a toughness which practically no other timber possesses, and this allows of curved members being cut out of the plank direct and of their being worked up to an almost incredible lightness, after which they fill their purpose perfectly; very seldom indeed are there accidents where ash is used. If dry it is remarkably constant—it does not swell and shrink with the sensitiveness with which some timbers do, and its extremely tough and fibrous nature almost make shakes—such as exist in oak—an unknown quantity. Ash has one failing, however; it will not stand exposure to wet, like oak will for instance, but the prime quality present in ash—its toughness—is altogether absent in oak, which splits and shakes very badly. Good English oak will stand a great deal of exposure to wet, and but for the above-mentioned failings might be used very much more than it is. Consequently it is used only for bottom framing, seat framing, and floor and landing boards.

A good deal of substitution is practised in regard to ash, and foreign ash, chiefly American, is imported and used.

Much of this is very good, but the fact that the great bulk of it is forest-grown detracts from its value, as it is by no means so tough and fibrous as when grown in single trees, hedgerows, or very small plantations, the exposure to the elements causing solitary trees to develop a sturdiness which forest-grown trees do not possess. The forest-grown tree, in its efforts to reach the sun and air, is drawn up quicker, and is, on the whole, more supple.

A timber very favourably considered by some, especially on the Continent, is beech. This is tough, keeps true to shape if dry, and is very durable. It is, however, very sensitive to atmospheric influences, swelling and contracting with damp or dryness, which has a bad effect on the joints.

Mahogany or American walnut may be used with decided advantage for solid waist rails such as are shown in the chapter on that subject. Mahogany works up nicely, paints well, and is generally ideal. Walnut is harder as a rule, and requires more careful priming, but if dry is remarkably constant.

Other timbers may be used here and there, but unless there are very decided reasons for passing by those mentioned, either equal qualities in the substitutes or scarcity of those named, they need not be troubled about.

The best panel timber is Honduras mahogany. This is mild, fibrous, very constant, and paints very well indeed. The various other kinds of mahogany are by no means so good; some are hard and tend to split, others warp easily, and generally show faults which are not permissible in body work.

At the present time the question of wooden panels hardly calls for remark, as the almost universal use of

metal panels, made necessary by the adoption of streamline shapes and round corners, eliminates wood entirely.

The other panel timber is three- or multiple-ply boards which may be used in some cases, but where they *can* be used so can mahogany, and mahogany is much more reliable.

Roofs of canopies may be of mahogany, but they are very frequently covered with three-ply birch or whitewood boards. In the case of there being much shape to the roof, moulded boards may be used, but this does not lend itself to individual design and characteristic work such as many builders still try to include in their productions.

What is commonly known as cedar is really unsuitable for work making any pretensions to quality. It is very fickle—splitting, buckling and warping—and even if glue-blocked to preserve it from splitting or warping, it will even show through the paint each individual block on the inside, faceting the panel in an objectionable manner. It is much better to leave it alone.

Floor boards and inside casing boards may be either yellow deal or three-ply. Seat boards, if any, may also be of either of these.

For covered roofs yellow deal or whitewood, matched, may be used; this allows of a better shape being obtained than is possible when a single panel of three-ply is put on, which may very likely cause distortion of the carefully framed and built-up roof.

For interior decoration and finishing details and glass frames mahogany, walnut, or figured sycamore may be used. Any of these make up well for all cabinet work and take a high polish.

The cabinet work may be veneered and inlaid, and such work extends in some cases to the roof, doors, quarters

and front lining boards, all of which are often very elaborately decorated in veneered work.

All timbers may be bought ready for use, but in the case of home-grown timber this is not always done. It is easy to distinguish home-grown from imported timber at a glance. All home-grown timber is planked out of logs without being squared up, ash always being cut with the bark on; oak is nearly always stripped, as the bark is used for tanning leather. The foreign timber is always squared up, and is imported ready sawn into planks of various thicknesses. One reason for this squaring-up is that in transporting the material from its source of origin it occupies valuable space, and a glance at a log of planks of English timber will soon convince anyone that it would be very wasteful to occupy shipping space with such irregular planks, and therefore it is more economical to cut away irregularities and send stuff which will pack closely.

If timber is bought as being dry, it is well to deal with firms of repute. If facilities are to hand for storing, then it may be bought as convenient. It should be stored for drying in suitable sheds until it is fit, careful records being kept of the dates when it was laid down.

Timber is felled when the sap is at its lowest ebb, and this is in the winter when it is practically dormant. The sap rises in the spring and flows back in part at the fall of the year, making during this process a fresh ring of growth which, in addition to the bringing forth and ripening of foliage and fruit, is part of the season's work.

After the trees are down the tops and branches are lopped off and the trunks are cut up into planks of the desired thickness of from 1 in. to 7 in., always with a definite idea as to possible requirements. The larger sizes are not, under present conditions of design, required for

body work as they were a few years ago, in the days of the fish-tail corners, which, if a good bold shape was required, called for 6 in. or 7 in. planks, so that the complete corner, with mouldings worked up in the solid, could be got satisfactorily. Incidentally, it may be mentioned that the piece, when cut out of the plank and when worked up, showed a tremendous difference in weight. These corners if now used would most likely be made up of framing and metal panelled with superimposed mouldings, but the round corner has come to stay in a general way. In one method of framing-up a scuttle dash 4 in. timber is called for, and though this is not absolutely essential it is quite common.

Stuff 3 in. thick will do for most things, but 2 in. stuff will cut by far the greater proportion of pieces for any body. The lock pillars, it may be pointed out, call for 2½ in. plank. Naturally, the purchase of logs, either in the round or cut up, calls for careful attention, sound, well-grown specimens being essential. Bent timber may be reserved for curved pieces, in which case cutting across the grain is avoided, but for all general purposes clean, close, straight ash is desirable.

Having got the timber cut into planks, the next matter to consider is both the method and period of seasoning. In the first place, naturally-seasoned timber is by far the best. Artificial drying is very considerably resorted to, but it impoverishes the timber and invites decay or faults which are absent from the natural-dried stuff. The natural method is to stack it in an airy shed, well protected from rain and sun. Particularly is this the case with ash, though it is not so important in the case of oak.

The best shed for the purpose is one built with solid

walls east and west, a honeycomb wall on the south, and the north side open, but with well-overhanging eaves. The honeycomb wall is built with holes the size of the end of a brick left between each brick. Such a shed will exclude all rain and sun, but be free to all the winds that blow. The floor may be prepared or be just an earth one, beams being laid down so as to keep the timber clear of the ground and so that air can freely circulate under the bottom planks. Too much stress cannot be laid on the matter of *free* air everywhere. If there is stagnation there is early decay, either damp or dry rot, and rot is infectious and soon spreads to more favourably situated and treated planks. A vital matter is to see that the packing or prop logs are true and square so as to ensure a true plank when it is dry. It may be remarked that the honeycomb wall is not an absolute necessity, although it is a decided advantage; to ensure its full efficiency care should be taken that it does not become choked inside or outside by vegetable growth or short ends and waste being stacked up against it.

If the suggested open-work wall is omitted and the end be open, the shed should have overhanging eaves on that side too, as the absence of direct sunshine and rain is as important as free air circulation.

Oak need not of necessity be stacked under cover provided that wet cannot lie on it or the sun play directly on a plank; a rough slab or two or a rough covering of any kind will prevent this and answer quite well, provided that free air circulation is allowed for. The timber should not lie in a forest of weeds and long grass, as this will ruin it very effectually. Prepare the ground outside and lay the necessary waste logs to keep the timber from the ground. In laying any timber up for drying,

having got the place ready, proceed to lay the planks; between every plank, and about 2 ft. apart, lay true battens, pieces of waste deal cut up, or any convenient timber of equal thickness.

One thing to do with all planks as soon after cutting up as possible is to strap the ends with a piece of stout hoop iron, which is nailed securely to the ends of each. This is to prevent the planks splitting up in drying, as they have a natural tendency to do, and which, if it happens, may cause very serious loss; the ends will split a bit whatever is done, but the splits will not usually extend far. The tendency to split is due to the natural movement of the wood drying, the outer parts of the plank shrinking more than the part near the heart; the contraction on the outside, being of a much greater extent, tends to pull the centre towards the outside, each side pulling in opposite directions. This natural pull is taken advantage of in cutting out pillars, which will be illustrated and commented on later. The shrinkage is greatest at right angles with the grain, and this tendency it is necessary to be aware of, either to use or guard against as the case may be. It will be readily understood that if this action takes place *after* the timber is made up no joint will be sound, no shape will be maintained, and the fact that so much moisture is left in the timber will cause other troubles, of which, besides those above-mentioned, the following are the most prominent: the grain will shrink and the less hard portions will sink, making the finished surface assume a ribbed appearance; paint will more or less peel and blister, but this action will be stayed somewhat when there is vent for the moisture to escape at the places which have peeled or blistered; joints will start and let in the wet, in which case the timber,

which before was perhaps "not quite dry," will, every time it is washed or exposed to rain, get sodden and swell rather badly; this condition will gradually get worse till the part or whole, as the case may be, will look very bad, and not only look bad, but actually will be bad.

When steel panels are fixed to timber which, if it is not actually wet, is not dry, the tendency is for the moisture to leave the timber and condense on the inner face of the panel. Even if this has been primed before fixing, the moisture will start the priming peeling, and rust is set up which very soon works through to the outside, causing trouble and expense with little or no prospect of a cure. The shrinkage of framing under steel or other metal panels, even if the last-named trouble does not develop, will pull and distort the panels to an alarming extent. It will displace screws, so that, even when they are soldered in and should be immovable, the distortion will break away the solder and cause every screw to show.

Anyone who has a deciding voice on the question of the fitness of timber should fully realise the importance of the matter, and there should be no possibility of "chancing it" when there is an element of doubt.

After hardwoods are planked they should lie under the best conditions—plenty of air and in a naturally dry place—for a period in proportion to the thickness of the plank. If the period from the felling of the tree to its final stacking in the shed is neglected, a minimum of one year per inch in thickness is necessary. This holds good up to, say, 4 in., beyond that—say 6-in. or 7-in. stuff—this will be found to be fresh in the centre even after ten years.

In cases where the history of the timber is not known its condition may be approximately judged by its appear-

ance. If uncut the aged appearance of the outside of the plank, with its attendant griminess and discoloration, is a guide. The initial cutting will tell whether it is dry. If wet the sawdust will be heavy and cloggy, and the crisp ring of the saw will be changed into a dead, laboured kind of sound; also, in the case of ash, the cut will show a decided pink cast, and the feel of it will be clammy. The hand tools will not work freely, the crisp cutting of saw or chisel being absent, and the shavings, instead of being crisp and springy and lustrous, will be limp and dull.

It is a decided advantage wherever possible, even with timber which is supposed to be dry, to give it a spell of what is called second seasoning. This is to get it cut out to patterns and stacked or otherwise stored in a dry shop for a time before it is worked up. With the small pieces this gives it a chance which takes effect much more rapidly than it can do in the plank, as many fresh outlets are provided for the moisture, and the results are decidedly beneficial. Any tendency to warp or twist is spent *before* the pieces are worked up for insertion in the body, with a reasonable prospect of the parts staying where and how they are required. This second seasoning is not to be confused with the system of super-drying in vogue in some places. With this method the timber, on being cut up and possibly machined up, is placed on a drying kiln and subjected to great heat, which quickly makes it absolutely tinder dry. This condition cannot be maintained when the timber is in use, particularly in this country where there is a lot of moisture in the atmosphere, as the super-dry timber absorbs a little and this starts joints, and then the way is open for the first real wetting the body gets to soak the wood. The system of practically cooking the

timber and the sap in it cannot be for the betterment of the finished article, and almost without exception such timber is subject to early decay if it is improperly protected by paint. It may here be noted that the best paint applied in the best possible way will not exclude atmospheric moisture. Note the condition of a well-painted and varnished panel when exposed to a moisture-laden atmosphere. The effects are very definite and more searching than exposure to actual rainfall. The paint and varnish appear to have a deep bloom on them, and the toughness and sticking powers are then greatly reduced.

There are several methods of artificially drying timber which need not be dealt with in detail. Naturally seasoned timber is by far the best, but, of course, if this cannot be got then artificially dried is better than wet or fresh timber. Good, well-seasoned timber is relatively scarce, and by the time it is ready for use is very costly. This calls for very careful marking up and cutting out so as to reduce waste as far as possible. With irregular or curved pieces there may be a lot of waste unless this point receives very careful attention, and as far as possible one piece should be worked out of spaces left by others.

Reference to the natural tendency of timber in drying has already been made (see Fig. 43). It is imperative in the construction of well-fitting doors, etc., that full advantage be taken of this. In the case of the standing pillars these should be cut with the *inside* of the pattern to the *heart of the tree*, as this holds the ends of the pillar when fixed, so that there is no distortion through the pillar tending to flatten out. The door pillars should be cut with the *outside* of the pattern *to the heart.* In this way a bit of nip is secured top and bottom, and with the lock in the centre the door keeps true and silent. The reason

for this is that the shrinkage increases in proportion as the distance from the centre of the plank increases. The greater proportion of shrinkage has a tendency, which develops in actuality, of pulling the more constant portion into a line in sympathy with that assumed by the outer position on the plank. Thus a door, if cut out with the pillars laid the wrong way round on the plank, will, instead of tending to gather a nip top and bottom so as to make a firm job of the door when closed and secured by a lock at about the centre, spring out and gape on the turn-under, and the top half, whilst not getting so much distortion, will not lie even with the standing pillar.

If the pillar is cut out as directed, with the outside to the heart, the top and bottom of the door will engage on the check of shuts, and the lock will be automatically kept tight *and silent*, which is a very vital point with motor-body work.

The use of bent timber, beyond that for hoop sticks, is by no means satisfactory, though as far as timber consumption goes it is very economical, as by its use parts which call for an awkward slice out of a thick plank may be produced out of a single piece of relatively thin stuff. There are most decided objections to the use of bent timber in body framing. First there is the question of strength. Now, in bending timber it is not possible to treat it as a substance which is more ductile would be treated, and which will stretch on the outside of the curved piece. There is only one place in the section which is constant and does not get distorted, and that is the centre of the bend. If the timber be ever so well soaked it will not stretch on the outside, and it will not contract into itself on the inside. If it gives on the outside at all it is owing to the fibres being burst more or less, and if it does

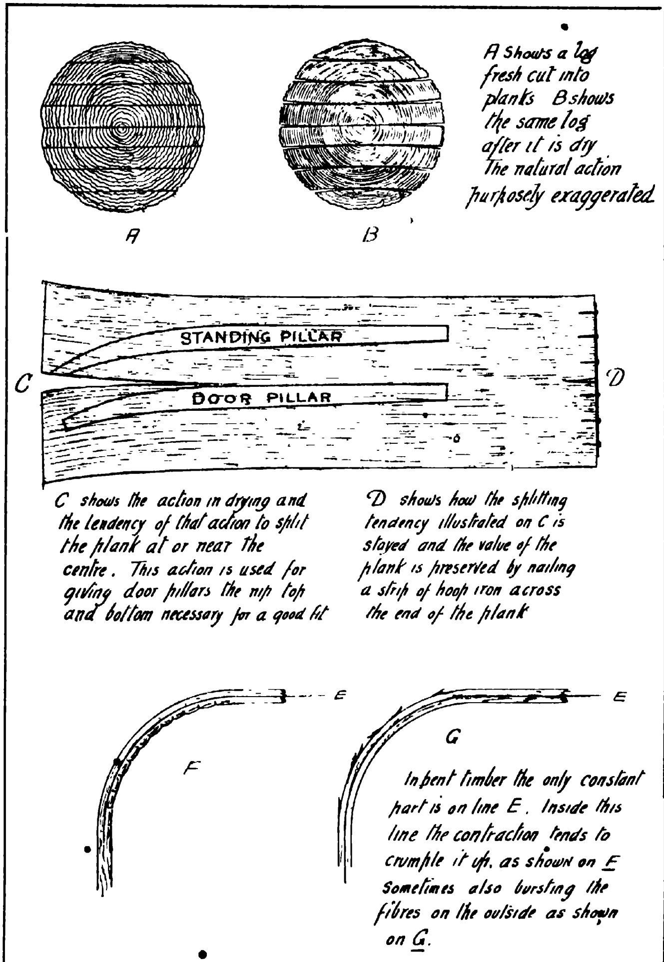


Fig. 42A.—Diagrams showing the Characteristics of Timber.

not break there, the inside crumples up, so to speak; this action is not always so apparent as real, but the fact that the tearing or compressing action has been in force ruins the timber. Even supposing the bends are suitable, they have been exposed to such action in the steaming as to destroy much of the virtue of the timber, and when bends are subject to damp they soon rot -sometimes even dry rot sets in. For hoop sticks, either for cape cart hoods or for closed bodies of the landaulette and cabriolet types, bent timber is indispensable. For framing it is quite unsatisfactory, as it rules shapes to a great extent and tends to distort in use, and moreover it is not strong. If used anywhere where it is uncovered the grain may crop out on the outside and break away as shown in the illustrations (Fig. 42A) dealing with the actual bending.

Ash is the principal timber which is used for bending. Birch is bent and used for wings, though not to a very great extent since the introduction of the more elaborate steel wings. Birch used to play a useful part in body building; a birch bootside at the rear, and frequently at the front seat as well, used to provide a good stiff, rigid foundation for the superstructure, but now its place is taken to a very great extent by beaten panels, and the lay-out of the framing is revised to meet the strains in another way. Chestnut is a good timber for bending, but it is not used much; in fact, very little bent panel stuff is used at present.

American whitewood may be used for certain parts, but it is not much used in modern bodies. Roofs may be covered with it in thin stuff matched together. It is fairly constant, and may be painted or stained and polished if desired. It is possible to substitute it for mahogany for some purposes, but in any case it should be dry.

Timbers Used in Body Building

Measuring Timber.—The general rule in measuring timber is to treat all thin and panel woods on the superficial method of calculation, both for reckoning up quantities and prices. The method with all hardwoods over 1 in. in thickness is per cubic foot.

Logs are reckoned in cubic feet, and by one of two systems—one which gives gross contents and the other which gives net contents when waste has been written off, so to speak.

The way to find the gross contents of a log is to find first the average diameter of the log by measurement or calculation, then proceed to find the area of an average section, which may be obtained by squaring the radius (half the diameter) and multiplying by 3.1416; then multiply the result by the length. If the calculation is made in inches the result must be divided by 1,728 to give cubic feet; or if the area in inches is multiplied by length in feet then the result must be divided by 144, which will give the same result with fewer figures.

Practice and system have decided that 25 per cent. of the total cubic contents of a log are waste—slabs, bark, and feather edges of planks accounting for this proportion. The correction may be made in calculations for value by either increasing the price per foot 25 per cent. or reducing the volume.

Another method of calculating the net contents is as follows: find the average girth by means of a string or measuring tape, divide the average girth by 4 so as to get the assumed face of a square log, square the result and multiply by the length in inches. Then divide by 1,728, which will give the contents in cubic feet of usable timber. The foregoing only applies to round timber. Many who handle timber in logs have ready methods of

their own for making calculations, more or less correct, which are generally on the lines of the second one given.

For planks the simplest method is to multiply length by width and thickness, using any denomination which is the most convenient. One way is to find the superficial area by multiplying length by average width of usable timber, in all cases, of course, neglecting feather edges, or at most only allowing a quarter of their extent to count, and then to multiply the result by the thickness over 12; 5 in. would be five-twelfths of a sq. ft., the answer giving the cubic contents; if 3 in. thick one quarter, any factor of 12 being reduced to the lowest fraction.

A ready method of finding either super area or cubic contents is by the duodecimal system. Examples of the super area will be given first.

A board 7 ft. 6 in. long, 2 ft. 9 in. wide; query, how many feet?

	ft.	in.	
Set out the figures thus:	7	6	
Multiply the top line by two, ...	2	9	
starting with the feet thus	15	0	
Then multiply the top line by the inches, and in putting down the remainder go forward one space thus	5	7	6
Result .	20	7″	6‴

or 20 ft. 90 in.

The first result is shown in feet, inches and twelfths of an inch; the inches and twelfths may be reduced to square inches by multiplying inches by 12 and adding the twelfths, or it may be convenient, where the figures allow, to make it into the fraction of a sq. foot; thus the result would be 20⅝ sq. ft.

The presence of fractions of an inch, both in length and width, are no bar to the use of this system, although it is not necessary in the majority of cases to go closer than the nearest inch, counting half an inch and over as one inch, and neglecting amounts under half an inch, which, if there are many or even several pieces to calculate, regulate themselves quite near enough.

The method of working fractions of an inch is as follows: a board 3 ft. $9\frac{1}{2}$ in. long, 2 ft. $5\frac{1}{4}$ in. wide.

Put down thus, counting the fraction as many twelfths	3	9	6		
Multiply by the feet first as before . .	2	5	3		
Then by the inches as before, going one	7	7	0		
space forward. Then by the twelfths	1	6	11	6	
column, going forward again one space			11	4	6
Total up	$9'$	$2''$	$10'''$	$10''''$	$6'''''$

Here we get perhaps the most exact area possible given, too exact for use, so we will mentally cancel out the minute fraction, when we get the nearest tangible figure, which is 9 sq. ft. $2\frac{1}{12}$ sq. in., which reduced to simple super figures is 9 sq. ft. 3 sq. in. Perhaps $9\frac{1}{48}$ sq. ft. would be near enough either for buying or selling.

Price Calculations.—If a large number of prices are being dealt with the unaltered results may be put down and totalled up, and then worked off in order to eliminate the minute fractions. Incidentally, the price of a piece of timber, of which the area is found by the foregoing method, may be got by the same system. In the case of shillings and pence per foot put the shillings under the feet column, pence and fractions, if any, under the other columns, calling $\frac{1}{4}$d. 3, $\frac{1}{2}$d. 6, $\frac{3}{4}$d. 9, and work out as before, cancelling

out the extreme fractions of the result as instructed for measurement calculations. These examples are purposely made very simple to give a correct insight into the system which may be employed on every sum where odd figures render simpler methods impossible. The alternative, in most of the cases which have to be dealt with, is to reduce to inches, multiply or divide by 144, but this is a clumsy method. The instruction given above for working price is given in a general sense only; if the price per foot is in pence, of course, put the pence under the feet column, as shown in the following example of the actual working:

The price of a piece of timber 8 ft. 9 in. long, 1 ft. 9½ in. wide, at 10½d. per foot super is required:

8	9			
1	9	6		
8	9			
6	6	9		
	4	4	6	
15	8	1	6	
10	6			
156	9	3	0	
7	10	0	9	0
164	7	3	9	0

= 13s. 8½d.

The method of working up the cubic contents of a piece, or a number of pieces, of timber is, so far as the superficial area goes, exactly the same. As already given, the dimensions are put into the column of the right denomination, and the multiplication proceeds. Then the thickness is put under the result of the first part, and the

multiplication proceeds exactly on the same lines. For simplicity in working where there are several pieces, the most convenient dimension may be multiplied by the number of pieces at this point.

For instance, four pieces of timber 13 ft. 9 in. long, $4\frac{1}{4}$ in. wide, $2\frac{3}{4}$ in. thick :

	13 9
4 @ $4\frac{1}{4}$ in. =	1 5
	13 9
	5 8 9
	19 5 9 = super area.
Now multiply by	2 9
In this case carry forward	3 2 11 6
the fraction one point	1 2 7 3 9
which gives	4′ 5″ 6″ 9‴9‴ as cubic contents.
The value of this @ 7/6 per ft.	7 6
	31 2 9 8 3
	2 2 9 4 10 6
	33 5 7 1 1 6
will be	33s. 5d.

All dealings in oak and ash or other large timber are on the basis of price per cubic foot. A load of about 1 ton of this timber is approximately as follows:

Round timber 40 cubic feet.
Squared timber 50 cubic feet.

Planks of various thicknesses are at the rate of 50 ft.

per load, and 100 ft. per load if 6 in. thick, which is double the number of cubic feet; other thicknesses may be reckoned in proportion.

Weights of Timbers.—The approximate weights of various timbers are given in the following list. Naturally, they vary considerably, a hard, close, knotty timber being much heavier than that which is straighter and more mild.

	Weight in lb. per cubic foot		Weight in lb. per cubic foot
Cork	15	Oak (Dantzig)	47½
Poplar	24	Ash	53
Mahogany (Honduras)	35	Beech	53
Cedar (American)	35	Oak (Canadian)	54½
Cedar	37	Oak (English)	60½
Cypress	37	Spanish Mahogany	66½
Pitch Pine	41	Oak (English, 60 years old)	73
Teak	46		
Maple	47	Lignum vitæ	83

For comparison it may be stated that a cubic foot of iron weighs about 480 lb.

Mahogany is generally dealt with at price per foot one inch thick. This does not imply that with boards ⅜ in. or $\frac{7}{16}$ in. thick that the price per foot is that fraction of the price per foot an inch thick, for there is the saw-cut to be added, and such thicknesses may very well be priced as half-inch. The system under which dealings are made in this timber is called "Liverpool Measure."

The basis of prices for deal of all sorts is the standard called the Petrograd standard. This gives 165 cub. ft. for a standard, and the weight is approximately 2½ tons, the weight of 1 cub. ft. being 39 lb. There are 1,980 sq. ft. of 1-in. stuff in a standard. A common dimension for small quantities of deal is the square 100 super ft., the

run, of course, being in proportion to the width; for example, 6 in. would be 200 ft. run, 4 in. would be 300 ft. run. It is usual to decide the price of any section by bringing it down to the foot run, although the calculations may be made by cubing quantities and finding price per cubic foot.

It may be pointed out that some people bring all the timber down to one inch in thickness in calculating, get the super contents, and multiply direct by the inches or parts of an inch in thickness, then price it at so much per super foot, at a price, of course, one-twelfth of the price per foot cube. This applies to hardwoods, of course.

There are several kinds of prepared panelling. "Agasote" board, which is a kind of paper pulp preparation, and "Sundeala" board, which is a wood pulp board, may be mentioned, but they do not enter very largely, if at all, into the best type of pleasure car bodies. Both may be used for roofs, both main roofs and canopy extensions, in the place of mahogany or ply wood, the regular, even texture and relatively high degree of constancy, combined with a good surface, enable them to be used for this purpose with advantage, but for panels their use is decidedly restricted, as is all wood or wood substitute for that matter, in present-day practice.

CHAPTER X

The Body-maker's Tools and Machinery

Hand Tools.—The present requirements of body-makers in the way of tools are very moderate indeed as compared with those required in the days before machinery came into such general use. An indispensable tool in those days was a frame-saw for cutting out shaped pieces of timber; this is displaced entirely in most cases by the band-saw. Much of the stuff was cut up with the hand-saw. The body-maker's mate or apprentice in those days used to have a good spell of slogging in getting the stuff cut out of the plank; now this is all done by the circular-saw and the band-saw. No body-maker's kit of tools used to be complete without a special wide-bladed axe for shaping-up pieces of timber in the rough; this again is displaced by the planer and band-saw.

All boxing, rebating, and grooving was done with routers, boxing tools and small planes; now this is all done with the spindle.

The planing-up of the rough stuff to square it up and prepare for marking-up had to be done with the jack and trying planes. These tools still find a place with the body-maker and a certain amount of use, but it is small in proportion to what it was formerly. Trying and jack planes are part of the necessary equipment, then come several smoothing planes, either of the old beech construction or all iron. The iron planes are slightly more difficult to use than wood planes, as they grip the face of the

wood more, but they are more accurate and work finer than the majority of wooden planes.

An almost indispensable tool for a body-maker is a "rougher" plane. This is a plane-shaped tool, narrow in the body, midway in length between a jack and smoothing plane. The face is rounded over, and the plane iron is ground and sharpened with a round edge. The handle, which is horn-shaped, is placed in front of the blade, so that the main action is a pulling one in using it. This tool will, if sharp, quickly reduce any portion into the neighbourhood of the proper size and shape ready for finishing off with a smoothing plane.

A number of small hand planes with compassed faces of various sweeps, and both concave and convex, are necessary; the number is decided by the workman on his ideas of what will meet his general requirements. A very good substitute for a set of wooden compass planes is an adjustable "Stanley" plane, which may, by turning a screw, be set to any radius either convex or concave. This plane has the added advantage that it works very true and very fine.

A body-maker will not get far without a set of squares, a large square board for setting up by, and ebony and steel squares of various sizes, also adjustable bevels which can be set to any bevel and fixed.

A good hardwood hand-saw is necessary and one or two tenon-saws; these tools only come in for very moderate use now, as wherever possible the cutting is done either on the spindle or band-saw.

A fair number of chisels are a necessity, and these should range from $\frac{1}{8}$ in. wide up to 2 in.; their uses are manifold, such as hollowing out timbers which are awkward for machine work, mortises, trimming-up

tenons, cutting and fitting laps, and a thousand and one little jobs. The sturdier square chisels are chiefly used for mortising and other work where a mallet is used for driving the chisel into the wood. For paring joints and fitting generally a bevelled chisel is a decided advantage, as it is possible to cut out a lap or stopped-lap joint cleaner and truer with a bevelled chisel.

Hammers of several sizes are a necessity, and of these first comes the large-faced framing hammer which is used for driving the timbers together, the large face preventing the parts hammered being bruised. A general purposes hammer, with a flat face and a wedge-shaped end, and a brad hammer, for driving in pins and use on lighter jobs, are also required.

The mallet is generally home-made from a good hard, sound piece of ash, and should do all the jobs called for without injuring the head. Boring tools are an absolute necessity; they are now required of two kinds, those for wood and those for steel. Those for wood are the ordinary shell, twist, and centre-bits which are used in a brace; the range of bits of the shell type should be from $\frac{1}{8}$ in. to $\frac{1}{2}$ in.; twist-bits $\frac{1}{4}$ in. to any size; and centre-bits the same, including with advantage an adjustable centre-bit which will open out large enough to cut a 4-in. hole or even larger. The bits for use on metal are of the Morse type and vary in size from $\frac{1}{16}$ in. to $\frac{3}{4}$ in. or so. The brace in which these are used is a wheel-geared tool of great usefulness.

Screwdrivers of several sizes are necessary, and should include those capable of being used in the ordinary brace.

Several spokeshaves and possibly a draw-knife will be required.

Among the minor tools a range of gimlets and brad-

awls is essential, and also a door-plate wrench. This tool, usually home-made, has a stout head with a handle; the head is cut to take the usual gauge door lapping with just a moving fit. When the lapping is on and the door hung, the clearance and set of the lapping is adjusted with this tool, which will raise or lower the feather edge as required. Some men provide their own bench vice, but this is not now general. An absolutely indispensable tool is a bench dog or cramp; this fits in a hole in the bench and is screwed down like a cramp to hold the piece of work rigid on the bench when it is not convenient or possible to fix it in the vice.

A large assortment of cramps is necessary, varying in size from 3 in. to 12 in. capacity; also a large body cramp is essential, but this is not often provided by the workman.

Gauges, either home-made or bought ready made, are a definite requirement.

A set of good quality steel wrenches from $\frac{3}{16}$ in. to $\frac{1}{2}$ in., though not essential, are a valuable asset.

The question of patterns, which many men like to have of their own, hardly come under the heading of tools, and these will be dealt with in another chapter later. There is, however, one useful appliance which proves very useful, and that is a pair of compasses, either of the ordinary or beam type.

Some body-makers themselves make small planes for cleaning up awkward places which are inaccessible to ordinary planes, or shaped so that tools ordinarily used will not touch them, such as very quick compassed lines, mouldings and the ends of pieces, such as pillars, which may require attention after being put together. Very "quick" compass planes, bull-nose planes, various sizes of

T-planes, with the iron either at the centre or very near the front end, are useful.

Machinery.—For the production of high-class body work machinery is indispensable, and in this chapter this is dealt with in the order that ordinarily it would come into operation.

The first consideration is motive power, and this may be either gas, steam or electricity, preferably the last. An electric motor is always ready for use, and when not in use can be switched off. Also the power is easily conducted wherever it is wanted, and the fact that all machines may be in action at one time does not call for such a reserve of power as when the source is of the single-unit type. If gas or steam have to drive all machines at one time their power must be sufficient for the purpose, and consequently when only a few of the machines are running there is waste. With independent electric motors fitted to each machine more economical working results.

Of the ordinary wood-working machines, the first to be dealt with is the cross-cut saw. This saw is mounted on trunnions on a platform above the bench, the actual saw being circular. It should be installed in or near the timber shed, so that on the actual plank being found the requisite lengths may be quickly cut off. In operation the timber is laid on a fixed bench, and the saw being set in motion it is pulled, pendulum fashion, gradually across the plank.

The general cutting out is done in a special building in which are installed a circular saw capable of cutting up wide and thick planks, a planing machine, and a band-saw. The planing machine is also a thicknesser. The planing proper is done on the top of the table and the thicknessing is done underneath, a gauge visible to the

operator giving the exact thickness which the plank will be after it has gone through. The feed for this operation is automatic, the plank being carried under the knives or planing spindle on geared rollers.

The next machine is the band-saw. With this all cuts which are not perfectly straight are made, and swept timbers may be cut out very near to pattern; an expert sawyer may save a lot of labour on later operations by the accuracy with which he does his work. The actual saw-table is made to tilt to practically any angle, when, if the piece of timber is kept true to the table, the cut will be at the angle required. The band-saw, however, is not required for this class of work to any great extent.

The equipment of the mill is improved by the addition of a band-saw sharpener, in which the saw is caused to travel round on drums by means of an automatic drive, and each tooth receives the necessary rub with a file held and operated by another part of the mechanism.

In the body shop the vertical spindle is generally fitted up, so that the timber may be shaped-up on its way to the body-maker, going back to the spindle for further operations after being marked-up as necessary. The operations possible on a vertical spindle are amazing. In the first place, all the pieces for a body are treated, being fitted with best advantage to a pattern of the part (which is most accurately copied) almost as quickly as the parts can be passed across the table. When the timber has been marked-up, the boxing for glass runs, the rounding-up and general shaping are done. Tenons and laps may be partly or wholly cut, simply needing cleaning up and fitting.

Tongues and grooves can also be cut with facility; in some cases single-blade knives do the work, and in others

small saw-shaped tools are used, suited to the width of groove required.

The single spindle machine is generally used, though machines are constructed with two spindles revolving in opposite directions, and with these cutting against the grain, as is sometimes unavoidable with the single spindle, is obviated.

Mortising and boring machines are not much called for in best body building, the majority of joints being laps of one kind or another, and the fact that most of the pieces are very irregular in shape restricts the use of this machine.

Every body shop should have one or more band-saws. These may very well be lighter and smaller machines than the one in the mill, but they must be provided with an adjustable table. With this machine the body-maker will be able to cut up awkward pieces which could not be cut either in the mill or on the spindle.

Coupled up to one of the machines there should be a good wet grindstone.

A copying machine, which is really a wheelmaker's machine, is hardly necessary, as very little could be done for the body-maker on this.

A wood-turning lathe may be found useful at times.

CHAPTER XI

Body-builders' Patterns and How to Make Them

THERE are some patterns that must be made by mechanical means so far as the drafting goes, while others may, with advantage, be produced by freehand work.

For side sweeps, which will be dealt with first, it is imperative that the patterns should be a true segment of a circle. Now a scale pattern of even the faintest sweep may be made by marking out with beam compasses, but to try and make the same compassed sweep full-size on the same principle is impracticable, as the radius of some would be many feet, and the working up with a string would be far from accurate. Supposing that a side sweep six feet long, and having, say, half an inch compass in that length, is required, the best way to get this will be to obtain a deal board just over 12 ft. long and shoot one edge true. Then mark down from the true edge at the end of a 12 ft. length on a square line, a point 1 in. from the edge. Now draw a straight line from the centre (which should be marked in) to this point at both sides of the centre and cut off the slight wedge pieces which are above the lines. The edges should be shot true. Having got this piece of wood cut ready for use, get the piece of wood out of which it is intended to make the sweep and put in a stout panel pin or small wire nail at the extremities of the desired sweep, lay the prepared board on the uncut board with the centre line exactly midway between the pins. The board out of which the pattern is to be cut must be placed so as to give a free, clear passage for

the prepared angular-edged board. Now, when all is quite ready get a scriber or hard, sharp-pointed lead pencil and, placing it exactly at the apex of the angle, hold it there securely and travel the top board from centre to nail each way. This will give a true line to which the cutting out and planing up must be worked.

The method is shown by Figs. 43 and 44. The result should be a pattern having a dead true sweep. It must

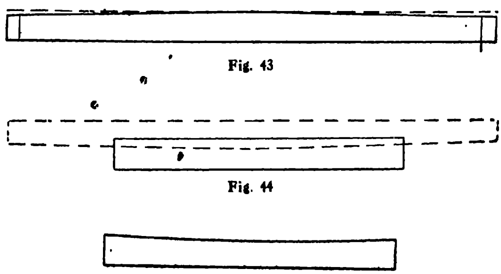


Fig. 43

Fig. 44

Fig. 45

Figs. 43 to 45.—Processes in Making a True Sweep.

not be forgotten that the angular board must be just over twice the length of the pattern it is desired to make, and that the distance marked down from the straight edge when starting must be double the amount of compass it is intended to give to the pattern. This method can be applied to all patterns which are to be segments of a circle. Fig. 43 shows the board prepared, the dotted lines indicating this, squared up and true, ready for marking off, and the full lines give the shape ready to lay on the board

shown in Fig. 44. The pins and the position of the scriber are shown ready for striking out the sweep. The result when the board is cut out is shown in Fig. 45.

Having prepared a pattern on the lines set out above, and worked it up as carefully as possible, the next thing is to prove it. To do this, get a board about a couple of feet longer than the sweep and, laying the sweep on it, draw a line the full length of the sweep, holding the pencil well in to the lower edge of the pattern, as a sharp, clearly defined line is necessary. Now take the pattern and travel it along the line slowly and watch the edge on the line; it should keep to it exactly or there is something wrong. Do this both ways, first to the right and then to the left, when, if it shows no error, the sweep is true. It

Fig. 46.—Method of Testing the Sweep when Made.

is perhaps superfluous to turn the sweep over left to right, but it may be done and the pattern tested further.

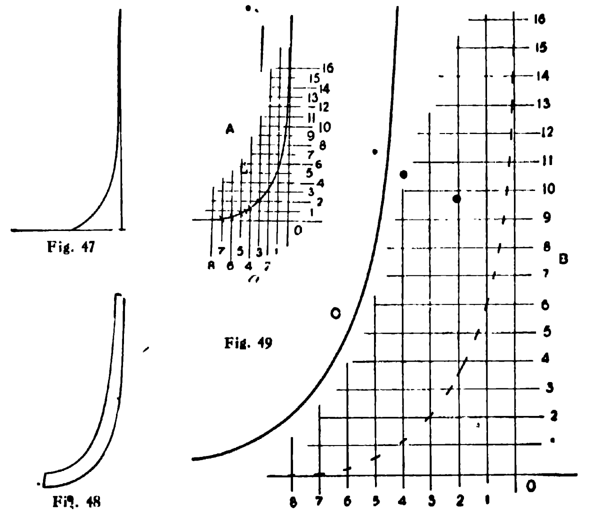
It need hardly be pointed out that the driest and most seasoned stuff only should be used for patterns. If unseasoned or too harsh in texture, they will twist and warp and at once lose their value. The method described above for large body side sweeps is also applicable to the smaller sweeps, of which some men make up a set of a dozen or more, numbering them from one upwards as the radius gets larger. The rate of progression may be in eighths or quarters of an inch according to choice, the numbering being for ready identification. Fig. 46 shows the pattern being tested, the full line being put in from the pattern, and the dotted lines giving the positions prescribed above are shown.

The sweeps, if made and tested as set out above, may be used with freedom and confidence anywhere on the edge for any part of the side which is to be made up to the true sweep. The necessity for marking the positions of the pillars or front or back is obviated, and correct work should result.

The next kind of pattern is one in which there is little mechanical work called for in the preliminary stages. This is the turn-under pattern, which to be at its best should be drawn to scale. A definite idea should always be in the mind of the draughtsman of what is wanted. A glance at the larger-sized sectional sketches in this book will give an idea of the sort of line required. It starts with a very moderate sweep at the top, and slowly increases the amount through its entire length. It is not possible to draw this pattern with instruments, or in any other way than freehand. It is better to do this to scale, having put in the dimensions—depth of panel and amount of turn-under decided upon—and then sketch it in as accurately as possible. The next thing to do is to prepare a wooden or celluloid pattern to suit the line drawn. It is possible, after a little practice, to accustom the eye to detect errors in line. Having got the pattern apparently correct, the next thing is to line in the sketched line with the pattern as a guide. If this line then fails to satisfy, it must be corrected as necessary, any undue flatness or roundness being carefully eliminated. Having got it satisfactory, it may be translated from scale size to full size. Fig. 47 shows the line sketched in, and Fig. 48 shows the pattern made to suit the design produced. Fig. 49 shows the method of reproducing the shape to a larger scale or full size. In the present case, as space is a vital consideration, it will be treated as if the original Fig. 47 were 1 in. to

the foot and it is desired to reproduce it 3 in. to the foot scale.

Whatever the scale of reproduction the work is exactly the same. In Fig. 49, A shows the pattern drawn in a right angle O, which is taken as zero in the plotting. The right lines which meet at O are divided up into 2 in.



Figs. 47 to 49.—Diagrams showing Methods of Designing, Plotting and Making a Pattern.

spaces, drawn in and numbered off as shown. The line of the pattern having been already drawn, next draw another right angle sufficiently large to carry the same number of spaces at the larger scale and mark off correctly to correspond with A. Draw as shown in B and number off. The numbering aids the transfer of one to the other.

Now mark off the line of the pattern, starting at either end, and carefully taking note of which point is being dealt with. A good way to ensure a careful check being kept as the work proceeds is to cancel off each point as it is dealt with, as shown at A. Mark off very carefully, as shown at B, and join up freehand. The pattern can then be cut out, and the result will be as shown at C.

For full size patterns the lines as shown at B may be put in with a square off a shot edge on the board and the others ruled in with a straightedge. It will be readily understood that it is far easier to design a good line and make it into a pattern to scale than full size, and whatever it is it can be reproduced on the lines indicated. It will not, of course, be necessary to continue this work indefinitely, as when a good pattern is produced its uses are many, and an excellent test of the value of a pattern and correct drafting is its many possible uses. A good turn-under pattern may be continued at the lower end, so that it answers for both side and back turn-under, although in the majority of cases the back turn-under is nearly double that of the sides.

The writer puts the above system forward as a great help to beginners, as much time and patience may be wasted if the making of patterns is not proceeded with on systematic lines.

The ram's-horn pattern, which is almost indispensable, is illustrated in Fig. 50. The gradually decreasing radius must be worked up true if the pattern is to be worth the timber used in its construction. To make a correct curve for the lower end or, to be more precise, that portion below A—B, the procedure is as follows: Get a round piece of wood or other substance (a cork will do if it is true) about one inch in diameter. Fix this to the board out of which

it is intended to make the pattern with a screw, and drive a pin into the side, either near the top or the bottom of the block. Next get a length of string or thread, make a loop at each end, hang one end on the aforementioned pin, and wind the rest of the line round the block. Having got it all wound round level and tightly, insert a pencil in the loop at the end and begin to unwind the string, with the pencil travelling on the board or paper, as the

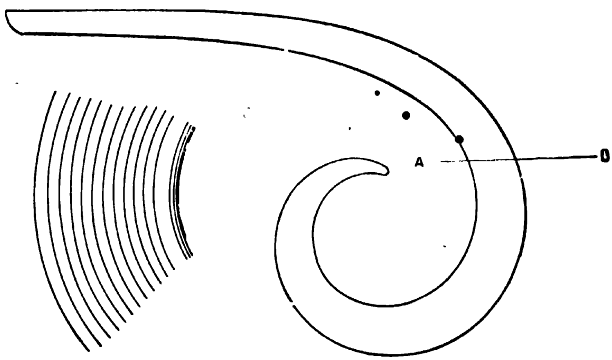


Fig. 51.—Parallel Lines Drawn with True Ram's-horn.

Fig. 50.—Ram's-horn Pattern.

case may be. Continue until the length of the string from pencil to block is about 6 in., and then turn the block round so as to reduce the radius by about 2 in. to 3 in., and wind up on the block again.

The turn-under pattern, made to the scheme illustrated in Figs. 47, 48, and 49, may now be added at the correct position on the spiral (Fig. 50). If the portion made is true any part will produce a parallel line to another part. For instance, if a length of line be drawn in at the largest

radius, by simply turning the pattern towards the smaller radius and at even distance, the parallel lines may be put in as illustrated in Fig. 51. This matter is very important, as the putting in of door bottoms and any other parts where the lines are parallel can be done with ease if the pattern is correct. It is very much better to put such lines in with a pattern than with compasses, as they do not look so stiff. The corners have one side slightly longer than the other, which, when seen in a foreshortened position, look quite even, whereas the foreshortening of a compass-drawn line must make one side look shorter than the other, and this, of course, is more apparent in the actual body than in a drawing. Take a door bottom, for instance. If it is put in with compasses the vertical line of shut will look as if it were carried down too far, and give anything but a pleasing effect. If, however, the line is put in with a correctly made ram's-horn, the larger radius upwards, the result will look vastly better; in fact, all other things being in order, it will be perfect. In the same way, when joining two lines of unequal length with a compassed corner the longer side should have the larger radius or ram's-horn.

The preparation of a ram's-horn pattern for small scale drawings is not very easy; in fact, it is almost a case for freehand drawing. Having roughed out the material, preferably celluloid of stout gauge, true it up with a file and sandpaper; test it when nearing completion by feel and sight, and then, when all looks right, try it on the lines shown in Fig. 51. If it answers this test satisfactorily, well and good; if not, make it do so.

A selection of such patterns are a decided acquisition, particularly if they are made in conjunction with return sweeps of various lengths and depths of curve. Some of these are illustrated by Fig. 52. It is not advisable to over-

load oneself with a lot of patterns which are rarely used, but stock sweeps and curves will hardly meet some cases, and an attempt at making them do will inevitably cramp the design and spoil otherwise good efforts. It is far better to draw the right line freehand and then plot it off to the desired scale.

A good line for the elbow of most bodies is hard to get if one only has the patterns already illustrated. In

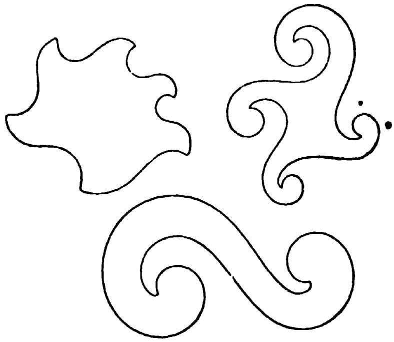


Fig. 52.—Small Ram's-horns and Return Sweeps.

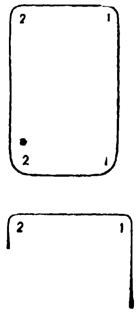


Fig. 53.—Corner Patterns in Pairs.

this case, again, draw the line and make the pattern with a view to its being a permanent item in the outfit.

An easy method of putting in the double line of the door lapping at the bottom corners in scale drawings where the radius is small is to have several pairs of patterns such as are illustrated in Fig. 53. The patterns should be dead square, and then the corners should be made on them, one slightly smaller radius than the other, so that the lines may be put in at one stroke instead of making up the corners on to the straight lines. This latter method is rather

troublesome and seldom gives a clean; neat job, particularly with ink. It should be pointed out that any celluloid except the very thinnest will do for patterns for pencil work, but for ink they should be about a millimetre thick, and the edges, *after* the shape has been made correct, should be well chamfered off (at about 45°), though the edge must not be so fine that it will be easily damaged by the pencil or pen.

In the case of patterns for full size drawings for a side sweep a bit of clean, dry deal or whitewood will answer admirably. For the smaller sweeps and the turn-under pattern mahogany of a nice clean, mild kind is preferable. For the ram's-horn, where in a plain piece of wood the shape would go across the grain several times, a piece of clean, well-made ply wood is essential.

For scale patterns celluloid is the best; it is fairly easy to cut, even when thick, and a clean scratch is sufficient to cause it to break on being bent. It is absolutely constant in shape, no change of temperature or atmosphere upsetting it, and it is also very durable. The transparent kind is, of course, preferable, but anything which comes to hand, white, black, or coloured, is useful. The great benefit derived from the transparent kind is that it is possible to see just where the line will come without a try on or many measurements.

For the simpler patterns, such as the side sweep and other plain compassed patterns, any thin wood will suit; thin fretwood is easy to work, or, what is perhaps best of all, if it can be obtained, is the single sheet of wood prepared for making up into ply boards. A consignment of ply boards will often be packed in waste pieces of this material, and they should be earmarked for patterns on sight.

With reference to the instructions on making sweeps given at the commencement of this chapter, it may be pointed out that another way of doing the same thing is to get two straightedges, each a little longer than the pattern to be made, and fix one end of each securely together by a bolt or screws at the correct angle. The angle is obtained by putting in a pin in the centre and one at each end, which gives between them the correct amount of compass. Having got all ready and tightly fixed together, get a sharp pencil, and after withdrawing the centre pin, travel both ways on the two remaining pins. This will give a fairly clean, true line, but not so good as the method first described. The fact that the two straightedges lie one on top of the other prevents accuracy somewhat. It is possible to use the same laths repeatedly and for any compass by adjusting the angle and tightening up.

CHAPTER XII

Framework and Joints

General Considerations.—The necessity for producing a light, rigid body calls for very careful attention to the sizes of timber employed and the method of framing-up.

The general idea must be to keep the sizes down to the lowest possible margin, and to use joints suitable to make a dependable whole. The question of lightness is, however, not the only consideration. If a member is too light there will be a giving and starting of joints which will lead to the ultimate ruin of the whole body.

In some cases the size is practically decided by what the individual part has to carry; for instance, a door-lock pillar must be a certain size to enable all the details to be got in satisfactorily. In this case the size must be such as to carry the waist rail, the glass run, and a garnish rail of sufficient strength to satisfactorily perform its functions; these conditions prevail in all pillars in which glasses slide. The width of the pillar, from shut inwards, is decided by the fact that it has to provide the necessary bevel and check-glass runs, and allow of the door handle spindle working freely without fouling the glass or glass channels.

The front standing pillar must be of a size which will allow of the front glasses being properly housed and also carry the front rail and garnish rail.

The fact that the lock has to be cut into the door pillar, thus reducing the effective section to a small amount, makes any attempt at undue lightness unwise. The other

pillars may be considerably lighter, but size reduction must not be carried to excess, as with the centre joints cutting into the timber very considerable reduction in strength results. The timber necessary for lock pillars must hold up $2\frac{1}{4}$ in. thick, and be at the top of the waist rail 3 in. from outside to inside.

As before mentioned, the hinge pillars may be lighter—$1\frac{3}{4}$ in. or a shade under on the outside, which means that the standing pillar must be $2\frac{1}{8}$ in. to start with or cut out of $2\frac{1}{4}$ in. stuff. The door-hinge pillars may be got out of 2 in. stuff and planed down to $1\frac{3}{4}$ in.; machined down for the check, this will leave $1\frac{3}{8}$ in. only on the inside. Front pillars of landaulettes call for 3 in. stuff, as the actual size on the inside of the shut must be $2\frac{3}{4}$ in. to $2\frac{7}{8}$ in. to carry the front. The doors and sides generally taper towards the bottom to a maximum of 2 in. on the bottom.

The general dimensions of rails and other framing are 2 in. × 2 in. nominal; if they hold up $1\frac{3}{4}$ in. it is plenty, as they are really only secondary members. The cant rail of nearly all types may be $1\frac{1}{2}$ in., or in some cases where special fittings have to be let in, such as cabriolets, it may be necessary to have $1\frac{5}{8}$ in. or $1\frac{3}{4}$ in. deep by $2\frac{1}{4}$ in. wide. In most cases the scuttle dash framing calls for large section timbers, but this is to enable the shape to be cut and then leave only the usual sections.

The bottom framing, in most cases, can be got out of 2 in. plank, which when cleaned up holds up $1\frac{7}{8}$ in. or perhaps $1\frac{3}{4}$ in., but it is wise to keep as near 2 in. in thickness where the bodies are wide (as most of them are nowadays), and the frame at the same time is relatively narrow.

With the upswept frames so general now the main runner is cut direct out of the plank, the plank thickness

going for the depth, and the rear portion, which is seldom of such a width as the main parts, is cut out of shorter pieces and spliced on with a plain splice, without any shaping or notching, and screwed together. This answers very well for the position, as the width is less and the body has more rigidity naturally at the rear than it has farther forward. The runner pieces are fitted to the frame of the chassis, and then the width required is made up by screwing pieces of 2 in. stuff of the shape required on to them.

The important question of timber sizes for the general framing having been considered, the next and most natural question to deal with is that of joints. Typical joints are illustrated, and they are arranged as far as possible as they come in rotation, starting from the bottom framing. It will be well to point out that by far the most commonly used joint is one form or another of the half-lap. The shape will of necessity vary, as the shape of the whole is so rotund that a true-gauged half-lap is practically out of the question; still, it does occur, as will be shown in due course.

Half-lap.—The half-lap, speaking generally, is by far the most serviceable joint. It is very easy to cut and fit, and it is also very easy to fix. A well-cut joint of this type properly coated with oil lead and tightly screwed is exceedingly strong. There is none of the element of chance in the fit such as may be present with a mortise-and-tenon, and if well made and properly fixed strength is assured.

Supposing the side members of the bottom framing are prepared and ready for joining up by means of the cross-bars, a half-lap joint is cut on the top of the side members and on its fellow on the underside of the back bar. This is not carried through to the back edge of the

hind bar; the bar will have been shaped up to suit the back turn-under, and if the lap were carried through it would call for turning over to finish off the ends of the side members to agree with this shape. Anything like this is needless, and as the bar is plenty wide enough to carry a good long joint it is quite satisfactory. An illustration is given of this in Fig. 54, in which the hind bar is drawn generally to shape and the joint made as set out above. It may be well to point out here that the method of drawing the joints as illustrated is on the system of isometric

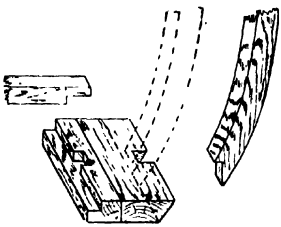


Fig. 55.—Bottom-side, Pillar and Cross-bar Framing.

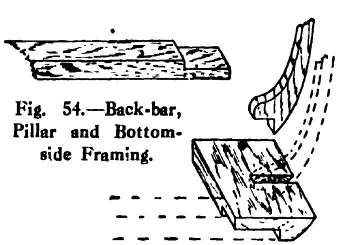


Fig. 54.—Back-bar, Pillar and Bottom-side Framing.

projection, a sort of false perspective view being made; the pieces are drawn approximately to scale, and then the perspective, such as it is, is worked in with the 60° angle of a set square.

The method of framing-in the other cross-bars of the bottom framing is either to half-lap them into the boxing or rebate for floor boards and screw through into the side members, or an extension of this such as is shown in Fig. 55. The cross member in the position shown in this sketch merely requires a footing during construction, as the main body plate is generally carried down the pillar with a good strong corner immediately at the base of the

pillar and then across the floor of the body along the cross-bar; this being screwed and bolted in position makes a really strong job.

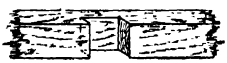
The pillars are let into the bottom sides with a kind of half-lap joint, the pillar itself being cut more or less vertically as illustrated, in which case there is ample material through which to screw, and the shoulder on the foot of pillar gives a good support in every way if it is well and truly cut and fixed well home.

It need hardly be mentioned that it is imperative that all joints be well and carefully marked-up and cut. The insertion of "charlies" is to be avoided absolutely. The joint may be made to fit by the insertion of these, but the job cannot be so sound and rigid or meet the enormous strains to which bodies are subjected if there is movement in the joints. Also the timber must be dry, or however well the joints are cut the shrinkage will upset it all. The method of joining the runners to the extensions of the bottom sides is also shown in this illustration.

For a stiffening to the plain joint illustrated the two faces which come together may be rebated to match, and then the screws get a bit of help in doing their work. Of course, the foot of the pillars in most cases is shaped so as to make up the rocker, but this is not shown, as it might lead to confusion. Whatever the shape, the actual shape of the lap joint is carried right through in all cases.

In Fig. 54 is shown a method of framing-up the back pillars or battens, whichever they may be called. The very sharp cut-away at the back, owing to the larger amount of turn-under, makes a joint such as is shown for side pillars impossible, the taper of the edge is so extreme. This calls for a much longer foot on the inside of the member, generally as shown, and makes the actual

fixing of the joint on the top of the hind bar imperative. This foot may be fitted directly to the top of the back bar or stumped in as illustrated. Usually the former method is employed, and the short-grained end of the pillar is reinforced with a small forged plate which is screwed in position. Another way of making this joint rigid is by screwing a piece of birch to the edge of the bottom side and to the side of the standard, in which case, if the joint has been well made, the result is absolute rigidity.



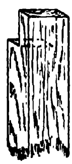


Fig. 57.—Mortise-and-tenon.

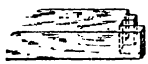
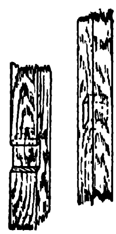


Fig. 58.—Stump-tenon and Lap.



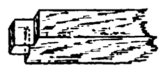


Fig. 56.—Half-lap.

Mortise-and-tenon.—The next joint to be considered is the mortise-and-tenon. Its uses are not very extensive, being in modern construction practically restricted to the framing of pillars into the cant rails (Fig. 56). The general rule for a mortise-and-tenon joint is that the mortise be about one-third the width of the piece in which it is cut. In some cases the piece carrying the tenon may not be so thick as the piece carrying the tenon, and then the tenon would be cut on one side, but as the cant rail is as wide as the pillar tops this does not apply here.

Great care is called for in this joint, as a badly fitting

tenon cannot be tightened up. Where it is possible to get pegs in to secure the joint without the ends showing outside these are used, and frequently the addition of screws in each side of the mortise right into the timber both sides of the tenon will ensure a strong, rigid job, the peg helping the screws and the screws helping the peg.

For most of the other joints in body construction the half-lap in one form or another is used (Fig. 57), and sometimes in conjunction with a stump tenon, as is the case with joining waist rails to standing and door pillars (Fig. 58). Various types of waist rails are given later, and in each case the type of joints employed is specified.

Stopped-lap.—The stopped-lap (Fig. 59) is used wherever it is necessary to carry through an edge without showing end grain. This is necessary owing to the fact that no matter how well end grain is prepared and painted it always shows. The joints start very readily, and if by chance the timber should shrink, be it ever so little, it leaves the end grain upstanding and the surface consequently uneven. With present practice this chiefly refers to door shuts and the standing pillars of these.

The door framing in almost every case may be made with a full half-lap, as the door lapping which goes round the sides and bottom will cover up the ends of the laps where they would otherwise show. The present-day use of steel or aluminium panels, which in nearly all cases completely cover the parts of the body which show, gives the body-maker a relatively free hand in the disposition and type of joint.

The dash framing is half-lapped together; the actual joints are of this type, be the shape whatever it may. If a dash-board has to be provided, or a frame round the

actual chassis dash to which to build up the scuttle, it is generally half-lapped, sometimes the joint being carried right through parallel, at others being mitred also; that is, the end of the sides are cut off at an angle of 45° or as agreed, the other piece being cut to match. This may perhaps be called a case of the stopped-lap. With a plain board which has its edges left bare, as sometimes occurs, this joint will ensure there being no end grain exposed.

In framing-up corners to the side and back rails, gener-

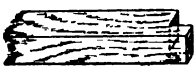


Fig. 59.—Stopped-lap.

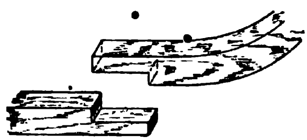


Fig. 60.—Half-lap on Elbow.

ally a joint as Fig. 60 is used; it may, as is most convenient, be cut either horizontally or vertically. If a special job is called for, and the joint must not open at the ends, as is important in some cases, the ends are cut dovetail fashion, and when the joint is screwed up with a bit of draw on the screws the end of the inside piece cannot roll up, the thin ends of each piece being keyed into the thicker pieces.

Although the illustration of half-lap (Fig. 56) shows the horizontal member stopped at the edge of the vertical one, the same applies to places where the pieces cross each other.

Lap.—The lap (Fig. 61) is generally used where pieces of a small section, or thickness, have to be joined to those of a larger section. Light reinforcing battens are usually lapped, in which case there is only one cut to make, and then the piece goes home and is fixed with screws. The lap may be either right through or stopped as occasion demands.

Another form of the half-lap, very irregular in shape, is that by which the bent hoop sticks are framed into the cant rails. This is a case, such as the foot of a pillar, where

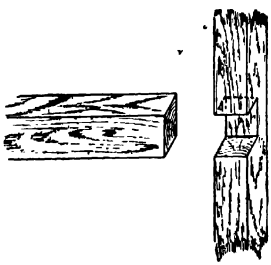


Fig. 61.—Lap.

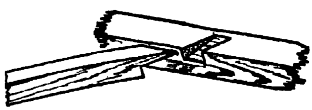


Fig. 62.—Irregular Half-Lap.

a gauged-lap would be impossible, or nearly so, owing to its wedge-like shape; a strong joint is produced, having plenty of stuff to screw through in one case and to screw into in the other (see Fig. 62). The extreme end of the stick need not necessarily be quite feather-edged, as owing to the fact that the roof is permanently covered the exposed end grain does not matter.

Rebate.—The rebate (Fig. 63) may be used either for a fixed or loose joint. The insides of pillars are rebated to receive garnish rails and lining boards, the rebate being carried through at the same depth all the way, and the

garnish rail, which is thicker than the lining boards, is in turn rebated to bring it flush with the line of the pillars. Fixed and loose bottom boards and seat boards are provided for by rebating the runners of the bottom-framing to the depth which equals the thickness of the boards used, and generally with width equalling depth.

Tongue-and-groove.—The tongue-and-groove joint is illustrated in Fig. 64, and this joint is chiefly concerned with deal or deal substitutes. Floor boards, seat boards, and sometimes roof boards and lining boards are tongued and grooved. The timber is usually bought ready prepared, although sometimes it is prepared as required.

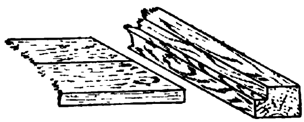


Fig. 63.—Rebate or Rabbet.

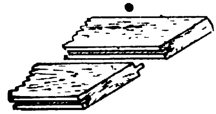


Fig. 64.—Tongue-and-groove.

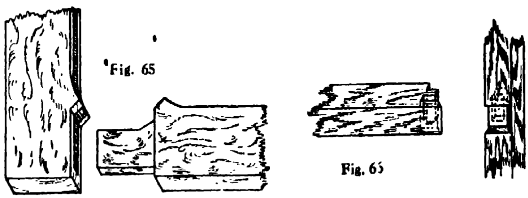
Generally the tongues are cut on one side and grooves on the other, but in some cases both sides are grooved, and then loose tongues are used which may either be strips of the same timber or strips of hoop iron. For some work cross tongues are required, in which case the grain of the tongues runs at right angles with that of the pieces joined together. It is much more costly to work with cross-tongued timber, as the preparation of the tongues and their insertion in necessarily short lengths takes much longer than the ordinary way, though very few cases in ordinary work call for it.

In using iron tongues great care is necessary to see that the grooves are well primed with good oil paint, or

rust may develop, and in doing so will split off, or at any rate distort the grooves, and the job will be spoilt.

Even with very thin stuff, when a place is boarded up with tongued and grooved material, the results are much more stable and rigid than would be the case without the jointing.

Mitre.—Fig. 65 shows the generally accepted joint for glass frames. It is a mortise-and-tenon with part of the joint mitred to carry the rounded corners generally used in such cases. If the corners are square the joint used is the same except that the mitred portion is left off and the



Figs. 65 and 66.—Slump and Tenons with Stopped-lap Mitred at Ends.

joint is quite straight. The mitre is used where it is imperative on one hand to carry one piece right across another and when it is equally imperative that no end grain should show. An example of a case of this sort is Fig. 66, which gives a general idea of how in some cases the waist rail must be framed into the pillars. The main efficiency of the joint lies in the stump-tenon, but as the rail must show a minimum of joint on the outside, the actual outside joint is across the pillar. This illustration is not drawn to scale, but only so as to give a good idea of the general shape.

Dovetail.—The dovetail joint (Fig. 67) is now practic-

ally only used for cabinet work, tool boxes, and such-like fitments. The half-lap joint may be varied if desired by cutting one side of the inset member dovetail fashion, and this tends to strengthen it against lateral strains.

Stump-tenon.—The cases where the joints may be made with ease, and which only show a small portion outside, are dealt with either by mortise-and-tenon or lap, but the methods with waist rails, which may prove somewhat unsightly if due care is not exercised, are dealt with below.

Fig. 68 shows a rather old-fashioned, but not obsolete, type. In this case the rail is stump-tenoned into the

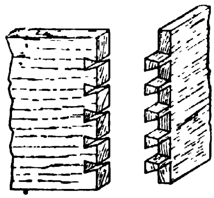


Fig. 67.—Dovetail.

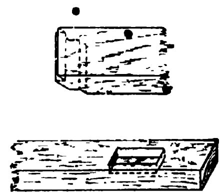


Fig. 68.—Stump-tenon.

pillars, care being taken to so cut it that the actual long joints come at a definite break in the general scheme. The pillar holds up to width down to the first moulding and then cuts back to the extreme edge of the waisting, and only shows on the actual face the short joints across the mouldings. The tenon is got well home and is held in position by screws through the pillar.

Various Applications.—The same method applies to Fig. 34, which is a more modern arrangement, as explained in an earlier chapter. Fig. 35 shows the application of Fig. 66. The rail is mortised into pillars and fixed

with screws as before mentioned, but to ensure the minimum of joint showing, a lap is carried right across the pillar, on the bevel preferably, as by this means the joint may be subjected to draw to make it tight and close. In addition, the edge of the lap may be cut with a dovetail which will, in the pulling up above mentioned, allow the pillar timber to grip the edge of the waist rail and so prevent it opening.

With the waist rail (Fig. 36) the stopped-lap can be used, as the actual rail is covered with a piece of panelling. The actual outside joint in this case will be either straight across the pillars or it will be cut on the bevel, the edge which joins the pillar being dovetailed as before mentioned and driven tight home before the superimposed panel is pinned in place, the actual edges or ends on the pillars being mitred to prevent the showing of end grain.

In the examples shown by Figs. 33, 34 and 35 the panel, whether wood or steel, is jiggered into the under edges of the rails; in Fig. 36 the panel is simply pinned or screwed on to the framing and then covered with the superimposed panelling, making a good, strong, firm job, and one that cannot shift. Fig. 37 is a variation of Fig. 35, the only difference being that the rail itself is plain and rounded over to an agreed shape. In Fig. 38 the pillar and rail are rounded in to the same pattern, and the actual joint is a true mitre for as far as the rounding goes, after which for the rest of the way across the pillars the joint is cut horizontally and the mitre joint meets true. The short length of horizontal joint should be cut with a dovetail to keep it rigid.

Fig. 39 is another case where the rail is lapped on to the pillar, the lap generally being stopped as shown. Position is not vital so long as sufficient of the pillar is

left to stand up rigid. The horizontal part of the joint may with advantage be carried a bit lower than drawn, and then, if the metal panel is cut to fit into the mitre neatly and then follows the line across the pillar, there is an opportunity to cover the wooden joint, so that there will be less chance for it to work should the pillars spring from one cause or another. If the pillars are covered with metal the only consideration for the joints is the most suitable type for a strong, sound job.

In this case also it is possible to lap right across the pillars, as the waist rail is covered with the main panel, without any break, and the actual edge of the panel will follow the line of the mitre, cutting across the remainder of the way in a horizontal manner.

Fig. 40 shows a much cheaper and a much more simple method of treating the waist rail. The rail will be mortised into the pillar on the inside, the actual outside joint being made to follow the mitre. In this case there is a variation from Fig. 38 in that the pillar rounding is not of such large compass as the waist rail. They are framed up flush on the outside, and the panel is pinned or screwed directly on and finished with a metal moulding of any suitable section.

It must not be thought that panelling of any description laid over the framing will make it permissible to use fresh timber. This matter has been referred to previously, but it is so important that a repetition in a slightly different form will duly emphasize it. If the timber is fresh it will contract, and in doing so it will draw and distort the panelling very badly; the fixing screws will get displaced and every head will show even after they have been soldered up.

Examples of the Uses of Joints.— In order to more

fully explain the application of joints, a set of timbers prepared for a body will be taken as an illustration and dealt with in detail.

The drawing Fig. 69 gives as far as possible on one sheet the general lay-out and assembly of the various parts, and an effort has been made to illustrate each piece in the most simple way possible and also to show their shape.

In this figure A shows the bottom framing side members made up as already instructed, side and top plan views being given. The back bar is shown in position, and the joints are shown cut for the pillars which are drawn immediately above. In order to assist in obtaining a ready grasp of the various views and their connections, fainter lines are shown coupling them up. B shows the back pillar in correct position and cut for fitting into the hind bar. The wheel-arch framing piece is shown by C, and this is framed into the hind standing pillar D. The extension piece which joins the wheel-arch timber to the back batten or pillar is also shown by C^1. The joints are reinforced by a corner plate which is fixed on the side of the pillar and along the top edge well on to the wheel-arch piece; this also helps to reinforce the short or cross-grained timber at the rear end.

The fixing of steel panels inside and outside of the wheel-arch framing strengthens it considerably, but to guard against accidents the forging C^2 is fixed, as is shown by dotted lines. The standing pillar D is shown in side and back view, and the joints to be cut on this are plainly drawn. There is the half-lap at the foot which is elongated by the insertion of the shaped block half-lapped to the foot of the pillar and screwed together through the pillar at the back into the block. Farther up the pillar

is the stopped-lap which is cut into it to receive the body batten, inserted to stiffen the panel. This joint is cut into the pillar only, and is of a size necessary to take the section of the batten.

Farther up still is the waist rail, which is cut into the pillar in one of the ways illustrated in the series of drawings of waist rails given earlier in this chapter. It is drawn in the present instance as a half-lap with the top edge mitred; and with a key piece on the inner edge of the rail to fit tightly into a keyway or shallow mortise. This acts as a very efficient steadier for the actual joint, which is fixed by screwing through the pillar into the rail. The end may be mitred so as to prevent the end grain showing on the pillar, but as this edge of the pillar does not come too definitely into view when the door is opened, it is not of vital importance. Finally, at the top is the tenon, which is cut for inserting in a through mortise in the cant rail. This joint may be fixed with hard wood pins or by screws driven through the cant rail into the top of the pillar, or by both.

The back quarter-light pillar is shown at F, and is stumped into the wheel-arch panel at the bottom and fixed with screws. The waist rail G is carried across this full size, and the pillar and waist rail are fixed together by screws through the pillar. The waist rail is continued past the pillar far enough practically to reach the start of the compass of the corner, and then the corner is half-lapped on to this as indicated. The corner piece H is cut out of a large piece of timber and finally reduced to the section of the plainer pieces of timber. Being very cross-grained it is essential that this piece be reinforced by a body plate placed either on the top edge or inside, and the plate carried past the ends on to the more sturdy timber

which is not so cross-grained. The back bar J is shown in back elevation and plan, and the latter also shows the corner of the back pillar and top back rail made up with a block of timber to carry the back moulding when this is used. The piece marked F[1] is the folding portion of the back-light pillar. The hoop stick, which is framed together as indicated, is fixed to this pillar either directly on the back as drawn or lapped on. If this is done the pillar and hoop stick fall more snugly when open.

The front standing pillar is marked K in the drawing. Side and front elevations are also shown. The foot of the pillar is shown with the extension piece in position; this piece is lapped into the bottom of the pillar as mentioned, when the rear standing pillar D was dealt with; the lap and shoulder are the same as D.

The lap joint cut to accommodate the reinforcing batten is higher up the pillar, and next is the joint which is cut to take the elbow of the front seat.

The elbow rail is cut to the shape indicated, and the full section may be let into the pillar direct, or it may be reduced to about 1 in. in thickness, the top edge being dovetailed to prevent any tendency to curl taking effect.

In the drawing the corner is shown made up by the insertion of a small block which is let into the elbow and front rail. This is optional, but it helps in the getting up of a good bold round for the finish of the trimming; a nice effect can be got without, but it is much quioker in the turn, and if the seat is made up semi-bucket type the larger the corner the better, and then again the extra piece is very useful. It will be noticed that the elbow and pillar joint is a stopped-lap, this being so whatever the depth of the lap. In most cases the actual joint on the pillar is covered with steel, the seat-side panel being

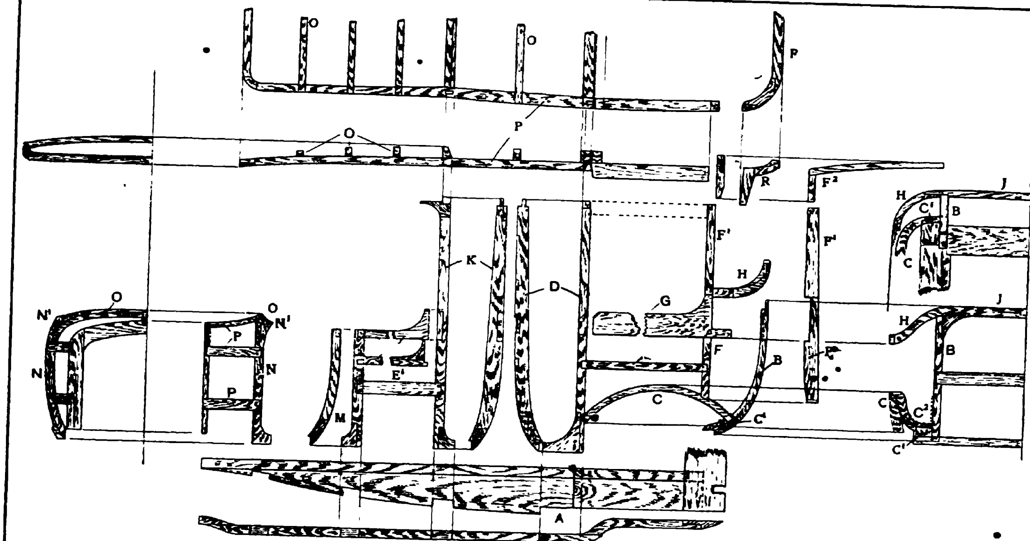


Fig. 69.—General Lay-out of Framing for $\frac{3}{4}$-Landaulette in Elevation, Sections and Plan, Showing Joints Throughout.

carried up past the joints in the timber, and in very particular work it may even go right to the pillar top. The essence of this joint, as in all those that are covered with steel or aluminium, is strength, the finer points of finish not being so important.

The pillar may be either as drawn or go direct up to the cant rail. There appears to be a loss of character if the pillar, after being nicely rounded into the elbow, is straight at the top. The radius of the top corner is less than the elbow radius, and the inserted piece is generally about half the thickness of the pillar and lapped into this and into the cant rail. The bottom edge is better if dovetailed into the pillar, as it steadies the edge. The top edge is also, if let into the cant rail, nicely hidden from sight and kept away from wet if carried up so as to be caught under the water cornice which is fixed on the cant rail near the bottom edge of the latter.

The elbow rail is cut direct out of the plank, carrying the shape at the back end. The front end is lapped on to the front seat pillar. The joint here used is the stopped-lap. The edge that must be considered for the elimination of end grain is the front or shut edge. To preserve the face the lap is stopped a little more than half-way across the pillar, and this allows of sufficient space for the fixing screws, and also ensures that the piece which runs right through shall be sturdy enough to carry the necessary panel fixing screws without splitting or distortion.

The pillar M is made up exactly the same as the main ones, but, of course, the section is lighter.

Next comes what is really the most difficult part of the body to many body-makers, though perhaps not so much in the actual building as the preparation for it. The projection of a scuttle dash and doors is shown in Fig. 9,

and the question of providing the extreme shapes out of simple pieces of timber calls for great care. The pillar N has to be got out of one piece each side, and the top rail O out of another, and between them they have to find the stuff which makes the turn-over corner on the dash at N^1. As before mentioned, these pillars call for a larger-section plank than any others.

The pillar N may with advantage be got out of 4 in. stuff, in which case it carries the extension of the foot without joining, as with other pillars. If this is done the piece that is cut out may be used for the front pillar of the front door. If carefully cut, the ends of this piece are large enough to form the laps for the top and bottom rails. The top rail O is half-lapped on to the pillars on the front side, and screwed through from the front.

The actual dash may in some cases be on the chassis; in other cases there is no dash at all, or there is a metal frame carrying the chassis details and having no provision for building to the body; and in yet other instances the actual body dash framing must stand by itself, clear of the chassis dash.

The present example has an aluminium dash to which a framed body dash is intended to be fixed. This is half-lapped together at the corners and shaped to suit the contour of the actual dash.

The stiffening battens P are not an absolute necessity, but they are an advantage if the body is built complete and ready for mounting off the chassis; in such a case the battens are let into the dash framing full section, which, as pointed out earlier, only means that one cut is to be made for each joint.

The next matter is the roof of the body. The cant rails are, where the shape of the roof allows, cut out in

one piece. If the shape is exaggerated the necessity arises of making the extension of separate pieces. The illustration (Fig. 69) shows this with the sides in one piece. The front bar is lapped on to the sides, each piece having a shaped end to allow of the corner being turned. If a larger radius corner is desired, then it is cut out separately and half-lapped on to the sides and front. The hoop sticks are cut to a true compass out of the plank, and they are half-lapped on to the cant rails as illustrated and screwed into position.

In domed roofs two intermediate longitudinal rails may be necessary, with lighter compassed hoop sticks and specially cut ends, framed separately into these rails and the cant rails. The wide hoop sticks are the same in principle as the small ones already dealt with.

The front top bar is tenoned into the cant rail, or it may be half-lapped—a stopped-lap on the top of the cant rails and screwed.

The hind hoop stick for a round-cornered body is either built up as illustrated or it may be made of a bend half-lapped on to the short side members (see R in illustration).

What is shown in Fig. 69 is, with the exception of doors, which are dealt with in part in another place, and some of the cross-bars, a representation of half a set of timbers for a landaulette body. Design may vary these in shape, but the principle will remain, and a careful study of the drawing and explanatory matter will do much to enlighten the student.

CHAPTER XIII

Head Fittings Practically Considered

HEAD fittings are for the purpose of enabling a closed body to be opened wholly or partly. It will be understood that requisite conditions in the operation of these fittings are ease of movement, rigidity and silence.

The question of head fittings for motor bodies has called for very much thought and ingenuity, and the number of heads now on the market is very great. In the earlier days the method of contracting the length of any head when open was very crude. For instance, a three-quarter landaulette, when the length of light behind the door first assumed something near its present proportions, was shortened by making the cant rails hinged at or near the centre, the front portion being made to lie underside downwards on the top of the rear portion by the fitting of plain brass butt hinges. In some cases even this was not done, and the flap of the head was allowed to lie, directly hinged, at the top of the pillar and extending a long way back, causing a long overhang and very great strain on the pillar hinges and the back of the body generally. The crude arrangements available were very unsatisfactory, and as a result some very good and really ingenious ideas were introduced.

In the landaulette body the amount of contraction is at the option of the builder, and can be arranged to meet the case. It is got by an arrangement of links on the inside of the pillar and cant rail, and may be either automatic or non-automatic ; naturally, the automatic is much

to be preferred, as the movement set up by raising the front edge of the flap of the head which folds down sets the entire fitting in motion, and at the end of the movement brings the cant rail forward in such a way as to reduce the overhang to very moderate limits.

There are several of these fittings on the market; perhaps the most popular is the "Widney," which is shown by Fig. 70. This figure shows an illustration of the head closed and the positions of the constituent parts—the usual type of hinge at the bottom, the connecting and actuating

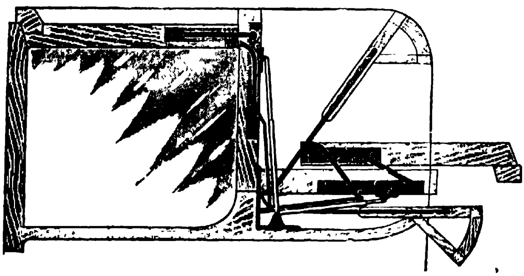


Fig. 70.—Automatic Hinge Fittings for ¾-Landaulette.

link fixed at or near the bottom of the pillar, and the shortening links on the inside, the one on the pillar being operated directly by the aforesaid link and the head spring. The links are set out and definitely fixed for position of centres on the plates as shown, thus ensuring a smooth and correct action. This fitting in its improved form may be bought as a complete unit ready for placing on the body, pillar and cant rail, leaving no centres for the body-maker to find.

Fig. 71 shows the same type of fitting, but made so as to be concealed when the head is closed, which is a decided advantage, as some people have an objection to the

head of the body looking like a hardware store. The links are covered with fibre plates which take the trimming easily, thus ensuring a good, neat job. This sketch shows the fittings as a complete unit ready to fix; the convenience of such an arrangement is obvious.

This fitting supplies a long-felt want, as it provides a hoop stick midway between that on the pillar and that on the front end of the cant rails. A long stretch of leather, generally 2 ft. or more in length, is bound to sag and look

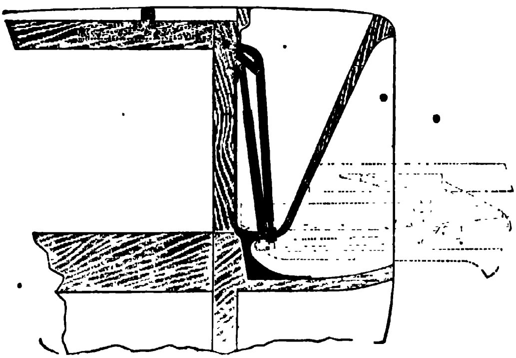


Fig. 71.—Concealed Type of ¾-Landaulette Fittings.

bad and also to hold water when it rains, and the intermediate stick, which, by the way, is nicely carried clear, holds this up and obviates these troubles. The main pillar hinge is essentially as it has been since the first opening heads were made. The springs may be either as illustrated in Fig. 71—operating in telescopic tubes—or they may be fitted on to a stout rod, which is hinged at the bottom and slides through a loop at the top and forces the spring into tension as the head goes down.

Single landaulettes and cabriolets, although not much in vogue at the present time, are occasionally in demand. In this case the length of quarter makes it imperative that the pillar should be carried back, so that the hoop stick which is fixed to it will clear the back squab, and not only clear it itself, but do so sufficiently to throw the leather and lining out of the way of the heads of passengers. For this a special elbow hinge or "swan's neck" is used, and this is so centred as to give the right throw-back and also to allow the pillar when down to lie in a correct position in relation to the standing pillar top. Figs. 72 and 73 show examples of this fitting. Particular reference should be made to the position of the bottom spring centre in the illustrations shown. In Fig. 70 the centre is kept close up to the pillar hinge centre; the actual compression can be traced in Fig. 71, and it will be seen how far back the centre is for the throw-back hinge; and in the figures showing the head open, although the springs are not clearly shown, it may still be observed how much contraction there is on them. The spring has several things to do; it has to help to keep the head up tight, to help the head up from the open position, and to lock the head when open. If the bottom centre is above a direct line from the top spring centre to the pillar hinge centre it will automatically lock when open. The amount of compression allowed for is generally the limit possible; that is, when the head is open the coils of the spring lie close together. All the springs are compression springs.

The use of the principle of the automatic shortening of the cant rail is not possible in heads where there is a throw-back hinge on the pillar, at present at any rate, and therefore to shorten the overhang of the cant rails there is a shortening hinge such as is illustrated in Fig. 74,

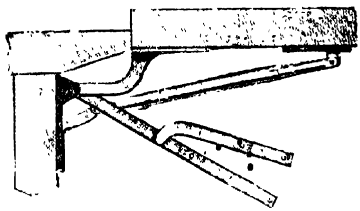


Fig. 72.—Single-Landaulette or Cabriolet Throw-back Hinge, shown open and closed.

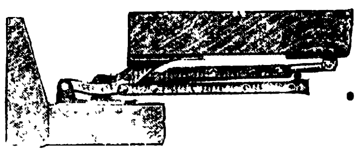
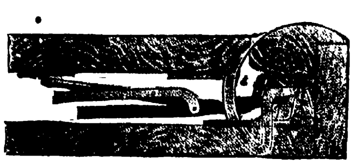
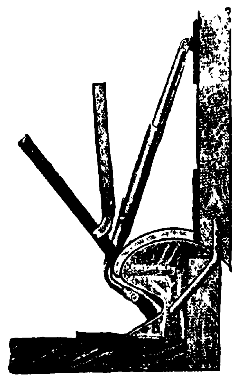


Fig. 74.—Non-automatic Cant Rail Shortener.

Fig. 73. — Another Throw-back Hinge, shown open and closed.





A guide for finding the centres for throw-back hinges is to lay the pillar in the position (on the drawing) which it is to occupy when open, so that it clears the back. Measure from the top point the depth of the pillar, then put the pillar in a perfectly horizontal position and, having found the back edge of the pillar, project lines downwards, at 45° from the top of the standing pillar at the back and

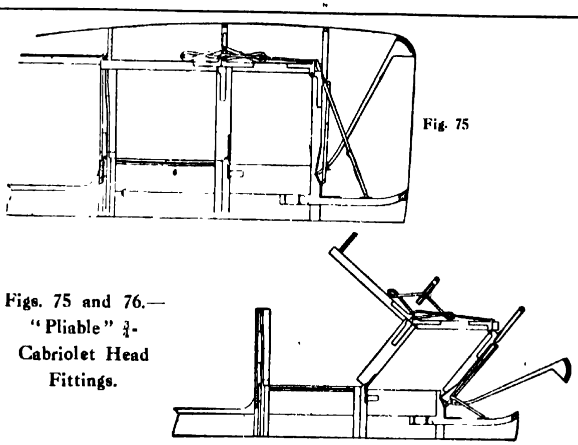


Fig. 75

Fig 76

Figs. 75 and 76.—"Pliable" ¾-Cabriolet Head Fittings.

the back of the folding pillar, and where they meet will be the centre for the hinge. The hinge may be any shape, but the distances from centres in a direct line are the matters of importance.

The type of head fitting already discussed is suitable for coupé bodies which have long quarters without windows, though these bodies are by no means common now.

For ¾-cabriolets and saloon cabriolets the inventiveness of the coach-maker has had good scope, and several

very good heads have resulted. One of the smoothest and easiest working for $\frac{3}{4}$-cabriolets is Grice and Harrison's "Pliable." This is shown in Figs. 75 and 76, and its introduction marked a further improvement in these fittings.

The question of fittings for a large head to open easily, not to crush or cut the leather and trimmings and which will lie snugly, is very complex. In addition to the other points mentioned, they must be easy to operate and be silent. These conditions are very exacting and must receive very careful attention from the body-builder.

A glance at Fig. 10 (page 45) shows a typical cabriolet of what is known as the $\frac{3}{4}$-type. Fig. 17 (page 55) shows a saloon cabriolet which requires an exactly similar head. This head may be fitted with a collapsible extension which is hinged on to the front bar of the body, and has joints which "break" in the middle; the front end carries a bar which fits on to the screen top. This is the type of extension suitable for many of the cabriolet heads. It is rather crude and heavy when open, throwing a good deal of strain on the hinges of the head fitting proper. It also calls for careful attention when opening and closing the head, and invariably requires a strap or two to keep it properly secured in the closed position. The problem in most cases with these heads is to carry the centre stick, or rather the stick which is placed over the hind door pillar. In many cases the front bar also causes difficulties, particularly if the body has a quarter-light which is longer than the door light (from front to back in both cases).

It would be a comparatively easy matter to fit up heads or provide fittings if all bodies were of the same dimensions, but they are not, and after the body has been designed and approved the fittings must be adapted to the body. Sometimes it is easy, at other times it is difficult.

The procedure is first of all to drop the hind pillar to the open position, and then to let the centre pillar down into position; this will decide one thing, and that is whether the front bar, board or hoop stick, whichever is being used, will fall clear of the back stick and allow the front part of the cant rail to lie horizontally, as it should

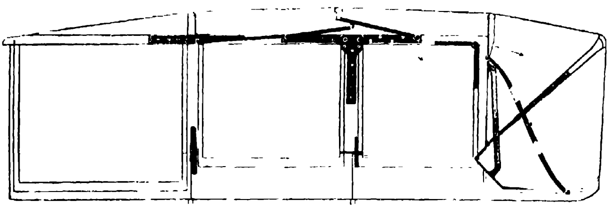


Fig. 77.

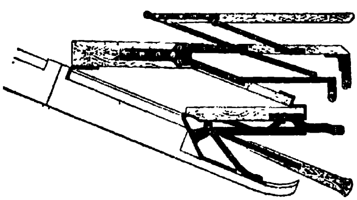


Fig. 78.

Figs. 77 and 78.—"Non-crush" Saloon Cabriolet Head Fittings Open and Partly Closed.

do. If the front bar and back pillar stick clear, then the question is, how is the centre stick going to lie, and where? If there is not room between the two already placed it means trouble, as it must go between and miss them, and, in addition to missing, there must be allowance for the leather and head lining, which is a considerable item.

It should be the first aim of the designer and builder

to get the overhang at the back, when open, as short as possible. Of course, it is realised that if a leather quarter is very short, as is now so fashionable, the hind pillar and its hoop stick and the back loose stick must fall direct on a fixed centre, but there is really no need for the remainder of the head, when open, to materially exceed these.

The "Non-crush" fitting answers most of the head problems in a satisfactory way. Fig. 77 shows this fitted up to a saloon cabriolet, and Fig. 78 shows the same fitting partly open, falling into position. This body has a centre door, and the entire head, with the exception of the front pillars, is carried in one easy action right back, snugly and closely, as is shown.

The front door-pillar top may be made to fold down along the front window on the top of the elbow, or it can be carried away with the head hinged to the cant rail.

Reverting to Fig. 77, it will be seen that the arrangement of ironwork is very clearly illustrated there, hinges, links, spring and finger-plate. In the following illustrations the centres and variation of fittings to suit various types of head are given.

Fig. 79 shows the fitting adapted to suit a cabriolet with a **V**-front. It will be noticed that the general arrangement is the same as Fig. 77, but the throwing up of the cant rails in a vertical position and then down to the horizontal should be noted. This case, being a saloon, allows the positions of sticks to be fixed freely. This allows of equalising the spaces fairly well, and also permits hoop stick No. 3 to clear No. 1 when open. Normally, the position of this hoop stick would be at 4, but a glance at the fittings and cant rails folded together will prove this to be impossible. These have not only to clear nicely, but they must

allow stick 2 to lie between with plenty of crush room. The carrying forward of this stick is done on an iron plate fixed to the centre portion of the cant rail and turned up to take the stick. The position of hoop stick 2 is found by making the centre links long enough to reach, when open, just about level with hoop stick 3. The extension past the centre carries the hoop stick. In the up and down positions the links are shown in heavy dotted lines, and the movements can be traced by following the arcs.

Fig. 80 shows a similar head, but the body is different, having a waist rail which is the same height all along. Fig. 79 has the front portion lower than the others, thus allowing the pillar to fall forward and still be level with the rest of the body. In this design, if the pillar was provided for in this way, it would be decidedly unsightly, so it is carried back with the head. Pillars 2 and 3 fall on hinges on the lower portions of the same pillars. No. 1 is hinged on the cant rail, and is carried away without any trouble at all. The links must be set and spaced correctly, and then the whole head falls neatly with the pillar between the front and middle portions of the cant rail, where it lies snugly and silently. Although hinged so as to swing freely, the opening and closing of the head brings this member directly to the correct position, leaving the entire side of the body neat and clear.

Fig. 81 shows a head which presents very much more difficult problems. If the centre portion of the cant rail is thrown up with front bar attached (this is a ¾-cabriolet), and the back portion with hind pillar and hoop stick attached is thrown up, it will be seen that hoop stick 1 would fall inside 3. To prevent this, instead of the hinge centre for the centre portion being on pillar 4, it is carried along to the top of the rear portion of the cant rail, in this

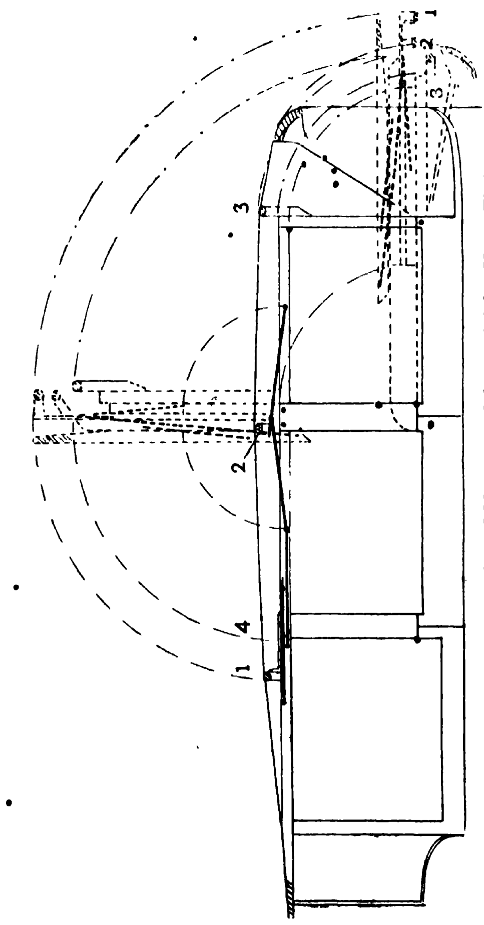


Fig. 79.—Working Drawing of Non-crash Saloon-cabriolet Head Fittings.

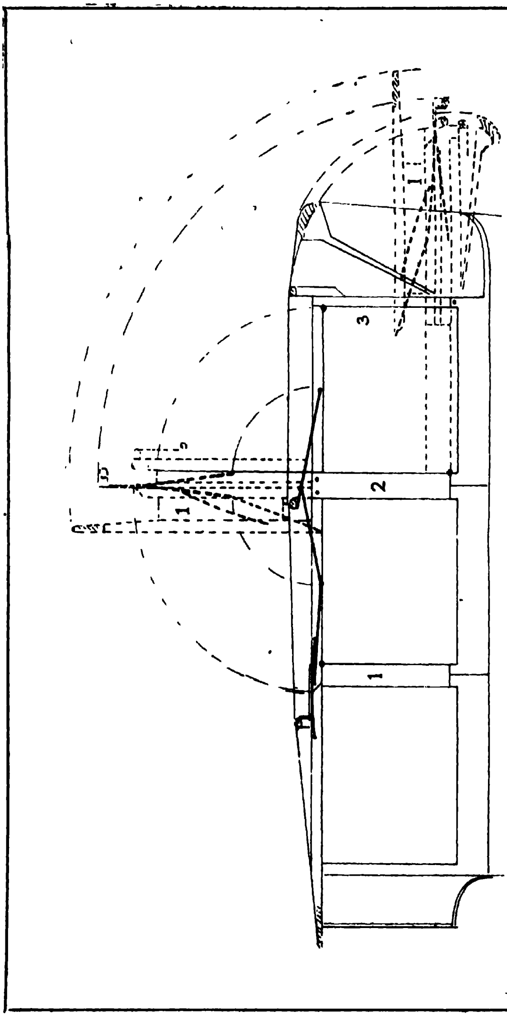


Fig. 80.—Saloon-cabriolet Head Fitting Carrying Front-door Pillar, Top-half Away with Head.

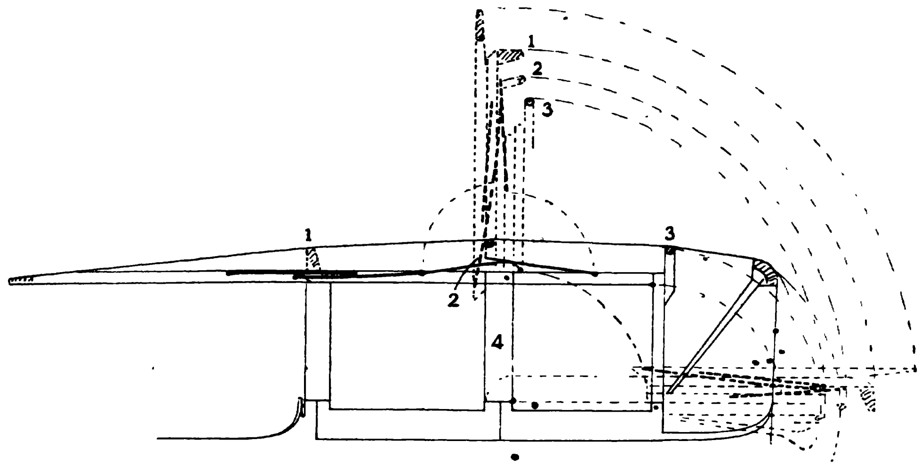


Fig. 81.—¾-Cabriolet with Narrow Door and Wide Quarter-light.

Door Portion of Cant Rail hinged on the top of Quarter-light portion to carry bar 1 clear of 2 and 3 hoops.

way giving us the desired length, or reaching length, on the centre cant rail. This adjustment may vary with different bodies, though the principle will hold good. The links must be adjusted to agree with this arrangement, otherwise the fittings are similar to the others.

The "Reliable," which is illustrated by Fig. 82, is another good head for three-light saloons. There are a number of others on the market which more or less efficiently meet the requirements of this type of body—easy movement, rigidity, silence, short overhang, and non-destructive effect on the head leather being desirable features.

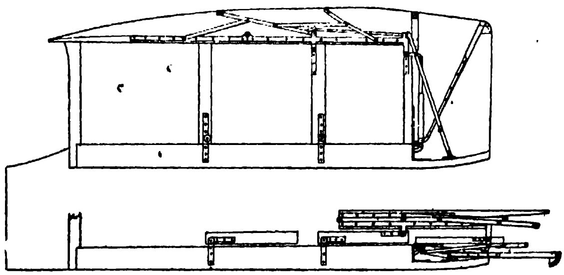


Fig. 82.—Another type of Saloon-cabriolet Fitting—"Reliable."

In the case of head fittings for bodies with two lights only there is a large number of fittings obtainable, and as there is only one stick no difficulty is presented. Fig. 83 illustrates a typical fitting, showing it closed, partly open, and quite open.

If, however, the quarter-light is narrow, and the leather quarter is also narrow, it may be found that the cant rail over the door lies too far back when open. If it does, this member may be cut in the centre, and the link arrangement, shown in Figs. 77 to 81, brought in, which will allow of the front portion of the cant rail being brought

forward, so that all the hoops and the extension over the screen lie level, or nearly level, across the tops when the head is open.

In fitting up practically all these heads, the question of centres is vital. In many three are found or provided ready for fixing, the two on the front pillar and the one at the top of the hind pillar. The one at the bottom of the hind pillar must be correctly placed to ensure accurate working and the proper position being attained when open. On the fittings shown by Figs. 77 to 81 the centres are regular. The bottom centre on the front pillar and the top centre on the hind pillar are actually dead on the line; this leaves the other two centres to be in the same position in relation to the corner as to each other. The top one on the front pillar is $\frac{3}{4}$ in. up above the cant rail line and $\frac{3}{4}$ in. forward on the pillar; the bottom one on the hind pillar must be $\frac{3}{4}$ in. back from the front pillar edge and $\frac{3}{4}$ in. below the line of the pillar top (bottom fixed pillar).

Where they are irregular the missing centre must be got by using compasses. Measurement of agreed centres for those on the cant rail must be taken, and the distance from the bottom centre on the front pillar measured off and a short arc described. Then the dimension between the centres on the pillar is taken, and from the agreed centre at the top of the hind pillar another short arc is described; the point of intersection is the centre. The nearer the centre can be got to the actual corners the better, as they fold more snugly and, in addition, are steadier than if they are provided with long, unattached angle pieces. The passing of these pieces over pillars prevents the use of trimming, and leaves an unsightly gap either when the head is open or closed.

With reference to hoods for touring cars, probably the

best fitting is the "Kopalapso." It is easy to put up and down, rigid, and the arrangement for any car allows of a good-shaped head when up and a very snug, neat position when down. The sticks all lie dead level and with a minimum of overhang at the back.

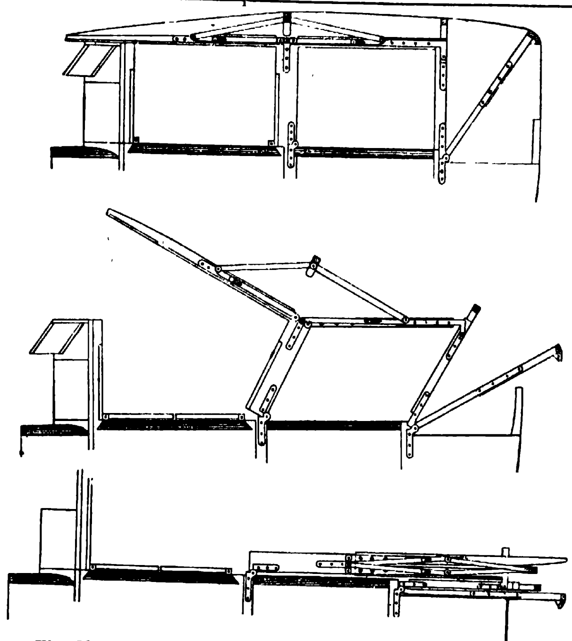


Fig. 83.—Head Fittings Closed, Partly Open and Open for Two-light Head.

There are quite a number of "one-man" hoods on the market, but it is unnecessary to study these in detail. For two-seater bodies the question of fittings is very well met, and there are plenty of very good types suitable for any body.

CHAPTER XIV

Panels and Panelling

Wood Panels.— In the days of the more or less square bodies, and even in some cases where the corners were round, the panels were all of wood, and mahogany was almost exclusively employed for them. Mahogany is still employed in some quarters wherever the shape will allow, and really it has not yet been equalled by any substitute. The best kind is Honduras. A good dry mahogany panel, properly fitted and fixed and well painted, will remain good for the life of the body. The mahogany was canvassed before or after fixing and reinforced with glued blocks all round the inside of the framing and battens. Where there was a moulding the framing was grooved out so as to take the panel, the edges of the latter being slightly bevelled off to give them a lead and to ensure the panel fitting tightly in the groove. No pinning or other fixing was required, but the edges were given a coat of white lead previous to insertion. They were pinned where they came flush to the framing or when superimposed, care being taken that the pins should not show unduly when painted. The edges of doors were pinned close to the edge so that the door lapping covered the pins.

Methods of Fixing.—A few words about the results of driving pins through panels may be of use. The universal practice is to punch in the pins below the surface of the panel to a greater or less degree, some holding that the pins should go just underneath the surface, others that they should go well under. If a pin is driven any-

thing like half-way through, as they sometimes are, it may with reason be argued that its holding power is less than if it had more stuff under the head. Wherever pins are put in one thing happens, the fibres are broken and pushed aside by the pin, and, if ever conditions are favourable, these fibres will tend irresistibly to return to their original position. It has been a very troublesome matter in body-building that pins will show. If they are driven in deeply the task of priming satisfactorily is made more difficult, but if the holes are thoroughly drenched with good oil paint the fibres may be prevented from rising through the action of damp. If they are well primed and then stopped up, the stopping if rather deep will dry very slowly indeed, and the slow drying causes sinking after completion. Perhaps the best way to prevent the above-mentioned troubles is to get the fibres, which have been parted and bruised, back into their original position. This can easily be done by soaking the wood with hot water, as this will prevent after-movement and reduce the requirements in the way of stopping. It has its disadvantages, however, as the application of water to ash raises the grain very badly and entails additional work when finally cleaned off, but if the pin trouble can be cured that way it is worth it. If the pins are just punched under the surface the fibres are held by the head and no trouble should result. In any case, the priming coat should be good oily colour, used very thin, and applied so as to drench the wood.

Other Panel Materials.—Ply woods have been very considerably used for panels, but generally with indifferent results. It is not possible to prevent a slight starting of the joints, and when this happens water gets in and generally parts the layers. Very wonderful productions are

possible in making ply wood up to templates, but the drawback is that it fails sooner or later, causing, in an almost unaccountable way, blisters and breakages on the outside.

Up to the present the panels referred to have been more or less flat or plain curved panels, for which wood may be used. Consideration will now be given to the more rotund shapes, and some of the ways employed at one time or another to get them will be dealt with.

"Roi des Belges" bodies were frequently panelled in sections, pieces of soft wood (deal or whitewood), were cut roughly to shape and glued together in radiating segments, being pinned through the edge. Then when the whole was together and dry it was dressed off to shape. The panel would then be covered with a glued canvas or other fabric, and when dry painted and filled up. It was slow, rather clumsy work, but found its devotees during the evolution of the motor body.

Mahogany at one time was chemically treated, so that it assumed a tough, ductile nature which enabled curved panels to be made and fixed, but it was not extensively used.

Some continental firms specialised in the construction of bent panel work, getting quite good, effective lines, but as there were many joints on the outside, and as joints will show, the results in a short time proved unsatisfactory.

Mahogany, other than Honduras, is very treacherous, and has a tendency to split unaccountably. A kind of mahogany generally known as cedar is very liable to develop defects of one sort or another, and it particularly is unsuitable for panel work.

From time to time various ideas have been brought

forward of building up panels of various substances used in a plastic state, but they have not been a success in the production of high-class body work. Papier-mâché is one such material, but one of the essentials of good work in this medium is suitable pressure to compress it to a sound, hard and closely-knit condition, and the limits in this direction allow only of very simple shapes and designs. As a substitute for mahogany for plain panels, prepared ready for fixing, it is very good, but it answers no better than metal as a general rule. It paints well and is constant if fairly dealt with in painting details, particularly in the priming.

Metal Panels.—Present designs and practice almost rule out the materials already mentioned, and the metal panel has almost a monopoly. There are two kinds of metal panels, steel and aluminium. In the early days, wherever there was much shape to be put into a panel, aluminium was used exclusively, the plainer ones being generally made of steel, but as the industry has developed steel has come more and more into use to the almost complete exclusion of aluminium.

Aluminium is very ductile and relatively easy to work. It is obtainable in roughly three grades of hardness, hard, half-hard, and dead soft; for plain bending the hard grade is the most suitable, for beating the half-hard is used. In cases where the panels are finished with mouldings, either worked up in framing or fixed after the panels are on, aluminium is very suitable, but where the panels, as in much modern practice, finish without mouldings it is not so suitable. There are two outstanding objections to aluminium—one is the difficulty in repairing damages, as if a panel is bruised it stretches and cannot be got back without much labour, which is an important matter in

repair work, or perhaps it cannot be got back at all. Another matter is the impossibility of satisfactorily stopping up screw heads with solder, as is almost imperative if best work is in view. Aluminium solders are to be had, but when used in practically every case the flux sets up decay and the joint breaks. Also a solder flux suitable for aluminium will not answer for steel or brass, and the result is that screw holes cannot be filled up. Aluminium panels can be satisfactorily welded however, and if the fixing screws can be kept inconspicuous and paint stopping can be employed a good job will result.

Steel of various kinds is used very extensively for panels and really gives the most satisfactory results. Steel, although harder and much stiffer, is very pliable under expert treatment, shapes being obtained very readily that apparently would seem impossible. Steel has one great drawback, and that is its liability to rust. Badly kept sheets sweat and develop rust which cannot be cured once it is started. Careless handling and faulty priming leave the door open to the same trouble, and the flux used in soldering leaves a very troublesome surface.

Lead-coated steel was very extensively used, particularly for panels finished with mouldings and for parts which could be got out of a sheet without cutting. It cannot be welded, and so its usefulness is restricted in present-day practice. Also paint will not adhere satisfactorily to lead and lead-coated steel, and no matter what is put on it is only a question of time for the paint to crack off, a film of very fine powder developing between the paint and the panel which leaves the paint with absolutely no hold on the panel.

Tinned-steel sheets are excellent for painting, but the presence of tin prevents welding, although the panels can

be soldered easily. This material, however, did not meet with much favour, possibly on account of the high price. Experience has resulted in the adoption of specially prepared steel sheets. These are of prime quality, not made of scrap, in which case the fibres are often coarse and faulty. They are not allowed to lie about for any time unprotected, but are immersed, as soon as cold enough after rolling, in an oil bath, and they are then carefully packed to prevent the oil being rubbed off, and the result is a faultless material.

Even with every condition satisfactory, the preparation for painting calls for extreme care. Every trace of flux must be removed and a proper coat of priming applied to the inside of the panel before fixing, and outside afterwards.

Panel Beating. — The beating of panels is a highly specialised operation. The first thing to do when starting is to take a paper pattern of the panel, or part of a panel, as is most convenient. Large panels must, of necessity, be made up of sections welded together after the constituent parts have been separately shaped up. For instance, the quarter panels and the back panel would be made up of three pieces, meeting and being welded up on the battens on the back.

The quarter panel may be taken as an illustration. Get a sheet of fairly substantial paper and fix it by pins or small cramps to the elbow framing, then fix it down the pillar as smoothly as possible. Next fix it to the wheel-arch framing and down the back pillar or batten. This will leave a considerable amount of fullness at the bottom owing to the rounding of the corner which acts both on the side and back. The fullness is gathered up as well as possible, allowing sufficient in the uneven, broken angular

surface to go round. The pucker or pleat in the paper will take the shape of a convex-shaped wedge when the pattern is taken off and opened out. This wedge-shaped piece is cut out of the pattern, and the steel sheet is then cut out to the pattern. The edges of the cut are brought together and welded up, making the flat sheet assume an irregular conical appearance at the weld. The apex of this is reduced by shrinking, or gathering, the metal, and this is gradually dispersed by hammering outwards, going to form the fullness of the bulbous corner.

Generally speaking, more shape is got into panels by gathering at the edges than by stretching where there is fullness. Thus, instead of reducing the thickness and stiffness, the panel is reinforced somewhat by the operation of beating it into shape. Fig. 84 illustrates the quarter panel cut out to pattern. The above mentioned **V**-piece being cut out, the edges of this **V** are brought together regardless of the shape produced. The fan-shaped points shown in the figure illustrate the direction of the dispersal of the metal after the actual apex has been gathered, and the actual gathering at the bottom edge is illustrated by wedge-shaped darts. It will be noticed that the bulk of the work entailed in beating this panel will nearly all lie in a small space on the part enclosed by the dotted line. The panel will require beating all over, because on the side and back there is compass both ways—horizontally and vertically—but a few times over with a planishing hammer on a suitable head will give this roundness.

In turning an edge over, as is frequently done on a round corner such as the curve at the junction of the front seat side with the front pillar, the edge is gathered, and then the gathering puckers are dispersed and the work

duly planished. The illustration, Fig. 85, shows this, the side elevation and section being given. Where the turnover is plain, as it is from the front end up to where it is marked **x**, it is simply knocked over, but from that point to the other the edge must be gathered, care being taken to see that the puckers do not extend more than

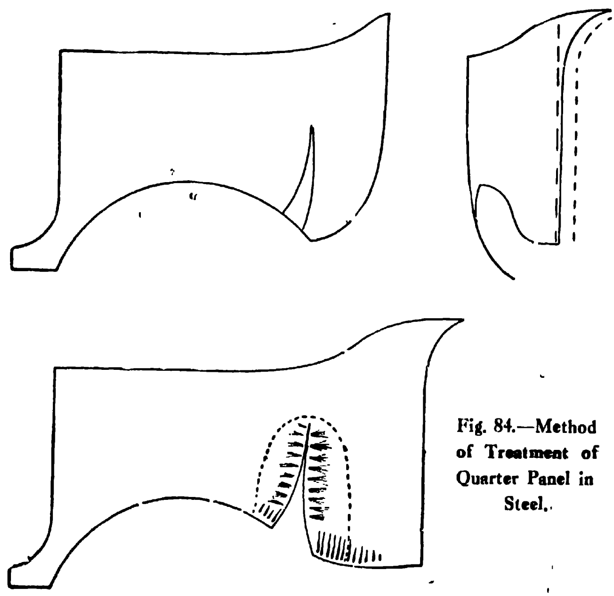


Fig. 84.—Method of Treatment of Quarter Panel in Steel.

half-way over the radius of the edge, or it will require a lot of work to get it back. If correctly done the smoothing out of the puckers will spread to the right point, which is the commencement of the more plain panel. The above hints will apply to most of the difficulties that arise in panelling-up a body. The fact that sometimes several

of the same kind of corners come all on one piece does not alter the principle.

In cases where a return sweep has to be panelled and the other line is round, as in dash panels, such as are illustrated in side elevation, plan and section by Fig. 86, a special course of treatment is called for. The back edge of the panel remains practically constant; immediately in front of this, however, the panel is stretched and rounded up. The front edge is gathered and contracted down to the actual dash-board shape, the puckers being dispersed so as to give a concave surface, which meets the convex shape of the stretched part in a correct position to suit the body shape.

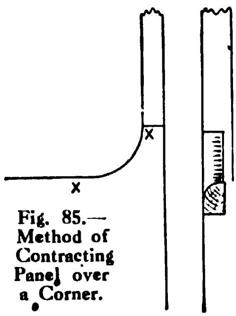
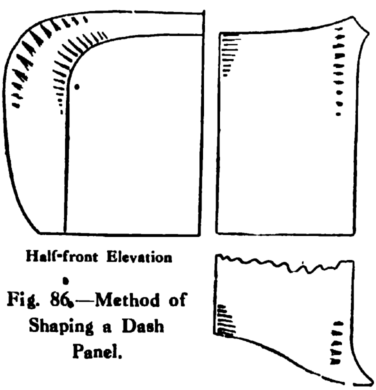


Fig. 85.—Method of Contracting Panel over a Corner.



Half-front Elevation

Fig. 86.—Method of Shaping a Dash Panel.

For panel beating the tools required are various kinds of snips, straight-bladed and with curved blades, boxwood mallets and special hammers. The work is done on "heads" of various shapes, each specially suited for different operations and shapes. These heads are generally made of cast-iron, and should be good, clean castings, free from faults of any description, particularly blow holes.

They are filed or ground up to a smooth, even surface, and should be kept up to condition by refacing as necessary. Whatever the compass of the work in hand, the compass of the head on which it is made should be quicker (see line on Fig. 88). For general large work, heads about 8 in. long and 4 in. or 5 in. wide, and true oval in shape, are used, as shown in Fig. 87.

These heads, in addition to the compass of the face

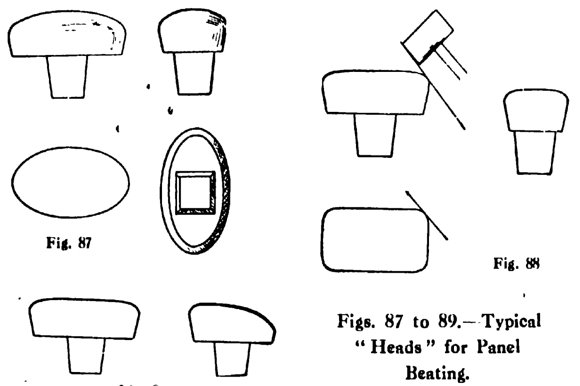


Fig. 87

Fig. 88

Fig. 89

Figs. 87 to 89.—Typical "Heads" for Panel Beating.

proper, have the edges rounded off. The compass of the face is about ½ in. each way. The depth is about 3 in. from the crown to the base. Each head has a square shank slightly tapered from top to bottom, and whatever the size of the head the shank must be the same for all, so that all heads may be used in the same holder. The head shown by Fig. 87 is typical of general beating and planishing heads.

For gathering a head such as is illustrated in Fig. 88

is used. To perform this operation the panel is held firmly by the left hand and hard up against the body of the worker, the edge lying about 3 in. beyond the edge of the head. The steel is then given two sharp blows, one on either side of the point of contact between steel and head, which produces the pucker before mentioned. This is repeated along the edge to be contracted, after which the unevenness of the puckering is dispersed on the type of head shown by Fig. 87 from the point on the panel to which the pucker extends towards the edge, thus upsetting the metal and producing the bulbous shape.

Another kind of head is the one used for rounding-up panels which, while having a lot of shape one way, are nearly flat the other way. The shape of the head is nearly flat lengthwise and has an increasing radius the other way as shown in Fig. 89.

The panel-beater's anvil is a ready-made article, whereas the heads are usually obtained from a local foundry, the panel-beater providing the wooden patterns. The anvil is a level-surfaced head, and for hammering and planishing panels is used with the convex face downwards.

The heads are held in various ways, sometimes in a post which has a substantial pedestal, at others in a beam secured to the bench and which is often reinforced by the addition of a prop near the head end of the beam. What has to be provided for is easy, uninterrupted movement of the panel at all times, so as to allow of every part of the panel being got on the head as desired. Sometimes the ordinary heads do not give sufficient room, and then a lengthening block is used into which the head fits, and the bottom of the block in turn fits into the socket which takes the stump of the head.

The thickness of steel used for panels is usually 20 gauge, as it meets all requirements most satisfactorily. It is stiff enough to stand up to shape and is not too heavy to work. If thicker material were used the beating would be very difficult.

Fixing Metal Panels.—In fixing panels of every description they should be laid in good oil paint, preferably white lead and oil, as it cannot be too strongly pointed out that trouble is far more likely to arise along the framing than in the middle of the panel. The framing, where it is jiggered out for panels, should have the groove filled to ensure proper results. This applies to both wood and metal panels. The fixing is done by means of screws, the panel being drilled and countersunk to take the screws, so that the heads are flush or slightly below the surface. As the screws are usually soldered up, the position of the screws is not important beyond ensuring a good hold at the edges. Usually the bottom edges are turned under the framing and screwed there, and, if necessary, screwed on the bottom edge of the panel. For doors on which lapping is to be fixed the screws can be kept near the edge so that they will be covered. It is a good thing, wherever possible, to solder up the joint of the lapping and the panel, as this prevents any tendency of the joint to shift and break the paint. The solder is, of course, kept to close limits and afterwards filed off level.

Unseasoned timber has a bad effect on soldered screws. The movement in the timber as it dries pulls at the screws and breaks the solder, resulting in a very bad appearance when the car is varnished. Wherever mouldings are to be fixed over the edges of panels the screws should be kept inside the limits of the moulding and so be completely covered.

It need hardly be pointed out that it is very important that the panels should be put on true and tight. They must be cramped into position by means of battens outside, so as to ensure that they will be free from undue roundness. Of course, if there is too much shape beaten in no amount of cramping will get this out, but if a well-beaten panel is put on slackly it will show the same ill effects.

The steel sometimes is turned into the edges of door shuts, but a good, clean square edge is not always possible by this method, and this detracts from the finished appearance, as although a knife edge is not desirable neither is a round appearance such as the turning over of a sheet of metal would provide.

The door-lapping may be either brass or aluminium. Aluminium cannot be soldered up satisfactorily when this metal is used for the panels, and it cannot be soldered up at all when the panels are steel. Brass cannot be soldered to aluminium, and it is not wise to use it with aluminium panels, as an action is set up in the panels due to the contact of the two metals. Brass should be used for steel panels and aluminium for aluminium panels, the latter not being soldered; also aluminium can be used with steel panels without soldering.

Steel panels, after beating, and right up to the time the painter starts on them, require most careful attention to ensure freedom from rust.

In soldering the flux must not be allowed to get all over the place, and what does get on the outside must be cleaned off with scrupulous care immediately it is possible to do so. It is rather a pity that some means cannot be discovered of satisfactorily using resin for the flux, but in its ordinary state it is not satisfactory.

Of the two fluxes, spirits of salts and fluxite, spirits perhaps are the safest, but it must, however, be carefully used and effectively cleaned off after use.

It should always be remembered that battens and pillars should be at least 1 in. away from the start of the compass of round panels, so that in the event of a pull or accident the batten or pillar does not kink the panel.

CHAPTER XV

Glasses.

In the early days of the motor-body industry the old carriage practice of fitting up glasses was adhered to in a general way, frames being used to carry the glass, but whereas the carriage glass frames were almost exclusively covered with cloth or velvet, the much more dirty conditions which motor travelling entailed necessitated frames of different material, and polished mahogany frames were introduced. These had strips of rubber or strips of wood, covered with cloth or velvet, fixed to the edges to ensure silent and easy running and silence when in any position. The question of protecting the highly polished surface of the frame necessitated the strips being slightly thicker than the actual frame. In the early days of motor-body building the turn-under was usually very much greater than it is the practice to make it now, 8 in. being quite common, and this made it a necessity to adhere to the old style of glass run in which the frame made a definite turn on its way down the run. The angle at which the glass lay when down as compared with the position when up was quite considerable, tipping under as it did at the bottom so as to keep inside the door thickness. A sketch of an old-type glass run is given in Fig. 90. The use of this method, combined with the greater turn-under of the body, made heavy timbers essential.

A glance at Fig. 90 will illustrate the position generally; the glass is shown up in the closed position, and to arrive

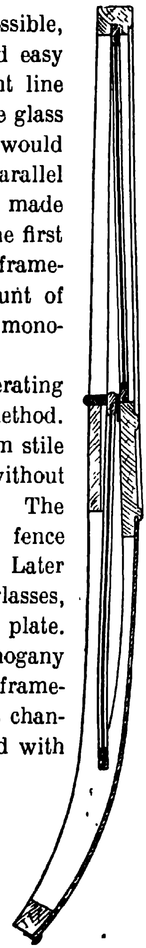


Fig. 90.—Section of Old-type Glass Run.

at the down position a straight run is not possible, so to allow the travel down to be clear and easy the pillars were boxed out, giving a straight line on the inside and a curved one outside, as the glass in rising strikes the run on the outside and would trap if the bottom were held to a straight parallel run. The modification of the turn-under made straight glass runs possible, and this was done first with framed glasses and afterwards with frameless glasses. The frameless type, on account of their much smarter appearance, very soon monopolised the whole of the better class bodies.

For a considerable time the means of operating the glasses was confined to the glass-string method. With frames these were secured to the bottom stile by screws and plates, and the frames almost without exception were lifted over the fence plate. The first frameless glasses did not lift over the fence plate, but just went straight up and down. Later the bottom channel, which is fixed to the glasses, was made with a lip to go over the fence plate. This method, by the way, was used with mahogany frames. The earliest method of fitting up frameless glasses was by inserting lengths of brass channel in the pillars. This channel was covered with velvet or plush, and if properly fitted gave satisfaction in every way. In cases where the glass, either altogether with the channel or the lipped channel only, was lifted over the fence plate, the channels in the pillars were cut at the top of the waist rail and swung on a screw at the top, allowing the bottom to travel outwards. This system is

employed to-day wherever the glass must go over the fence plate.

A great improvement came in when what is known as "Becklawat" (Fig. 91) was introduced. This is a somewhat lighter-gauge brass channel when compared with the older type, but it is sufficiently stiff for the job, and it has the edges of the metal rolled over to retain the liner of felt which enables the glass to slide quite easily and effectively prevents all rattle. With this material the glasses may either go straight up and down or lift over the fence plate as above mentioned. It is made in sizes to suit all reasonable thickness of glass, and is particularly neat, clean and efficient. A good, easy move-

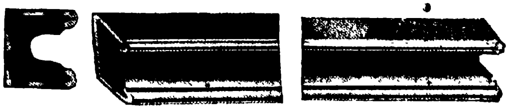


Fig. 91.—"Becklawat" Channel.

ment of the glasses made possible the introduction of mechanical means of raising the windows. The earliest of these was in the form of a spring balance on the lazy-tongs principle, so sprung as to lift the glass easily whatever the weight might be. Several ingenious methods were employed to secure the windows in any position. One was a screw attachment on the garnish rail, the female screw being under the rail in the form of a plate. The garnish rail and fillets up each pillar were loose and lined with felt or velvet, and the screw being undone let out the garnish rail with the fillets attached and allowed the glass to rise by the pressure of the spring which operated through a set of plates fixed up to make a lazy-

tongs. A knob or finger hook was fixed to the glass near the top.

Another way of securing glass in a desired position was by means of a fixed piece of rubber on the inside of the waist rail. Opposite this was fixed to the garnish rail another piece of rubber which was forced outwards by the turn of a screw, this second piece pressed against the glass so as to force it on to the outer piece and hold the glass.

One of the chief objections to straight up and down glasses in a body is the fact that, no matter how close and neatly the glass comes to the waist rail, it cannot prevent the ingress of water when it rains or the car is being washed. Good drainage may render this harmless, but wherever possible the glass should keep out the water, and to do this the glass must lift over the fence plate. At the present time practically all high-class bodies are fitted with mechanical lifters of one kind or another. The great difficulties are to be able to overcome the weight of the glass and the friction of the glass in channels without making the movement too slow and tedious. These are overcome generally by having a spring attachment which acts as a balance and leaves the lifting or lowering of the glass as the only work the operating handle has to perform, the action being as easy one way as another. Several fittings lift the glass by a spring only, leaving the lowering to be done by means of a notch, hole, or tab on the glass. A notch or hole is much safer than a tab of glass fixed to the pane, as the fixing of a finger-piece of glass to the pane tends to make it break easily.

Amongst the mechanical lifters which are now available are the following, which generally give an easy, rapid lift to the glasses: Gadsdon's patent is very smooth and

easy in working and lifts the glass quite easily and smoothly over the fence plate. The illustrations Figs. 92 and 93 show the fitting installed in the door, and the component parts can be clearly seen. The box containing the spring is shown in the door view. This spring balances the weight of glass, so that the only movement the gear has to make is to overcome inertia and the small amount of friction on the glass in the channels. It is geared to ensure easy movement up or down. A locking cone clutch in the fitting instantly engages on the handle being released, and this ensures the fixing of the glass in any desired position. The device may be obtained either straight up and down or to throw over the fence plate. This

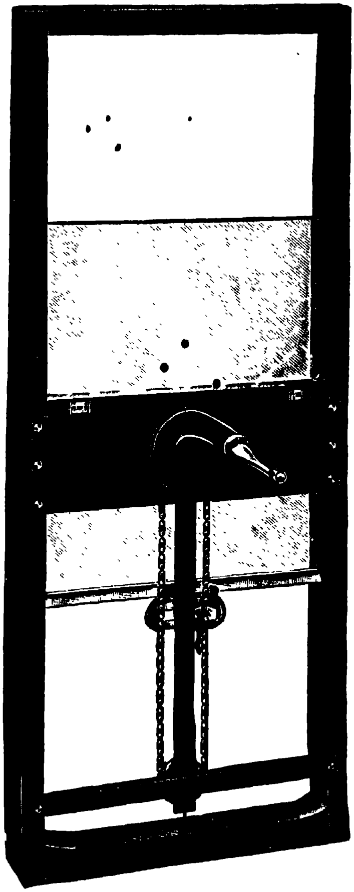


Fig. 92.—Gadsdon's Mechanical Window Lifter Fitted in Door.

latter operation is very neatly and accurately done. It is easy to remove either the entire fitting or to remove glasses in case of breakage.

Another fitting somewhat on the same lines, but with the spring box at the bottom of the assembly, is shown by Fig. 94. It is supplied ready to fix in position, and in common with all these devices is prepared by the makers to suit the depth of the glass or distance of travel of the glass. One drawback which is common to them is that they are awkward for most quarter-lights, as they extend lower than the glass can go, as the depth of the runs on quarter-lights does not represent the depth of glass which will go down. The fittings may be made to reach to the wheel arch and then allow the glass to go down to the point just above the centre of the bottom wheel. This makes their use for cabriolets almost prohibitive. It will be remembered that, when dealing with the question of the provision for glass in the quarter-lights on these bodies, it was pointed out that the depth of glass and of runs is controlled one by the other, owing to the fact that the centre pillar *must* fall to a horizontal position;

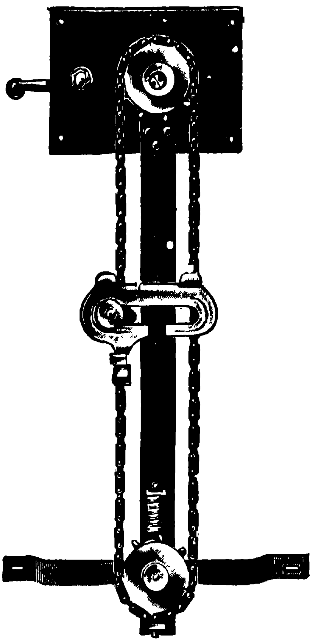


Fig. 93.—Mechanism of Gadsdon's Window Lifter.

therefore the use of any lifting appliance which makes a reduction in the glass-holding depth is next to impossible.

A type of lifter which is purely a balance, in that it has no gear or handle to operate, is Rawlings' roller lift and silencer. The design allows of full use being made of the glass runs, thus letting the glass down to a reasonable and workable position. It is spring-operated, something like a blind roller, the spring being put under tension as the glass is pulled down by the knob at the top. The glass is suspended on catgut fixed at the bottom and to the roller, the unwinding of the gut off the roller tightening the spring for action when the frame is released by a touch of the knob on the garnish rail.

Fig. 94.—Window Lifter with Spring Box at Bottom.

Another type of spiral spring lifter is the "Jackson." In this the spring is enclosed in a coil of aluminium tubing fixed together and ready for attaching to doors and lining boards. The tension may be made to suit any glass. As in the Rawlings, the pressing down of the glass tightens the spring ready to lift the glass as required; the operating handle is on the garnish rail, a half or a quarter turn releasing the lock and allowing the glass to slide up. This device is also economical as regards space re-

quired in the runs, the gut being fixed to quite a shallow bracket at the bottom of the glass. Neither of these last two fittings lifts the glass over the fence plate.

Another mechanical lifter is the "Hera," which is illustrated in a set of photographs reproduced in Figs. 95 to 100. Fig. 95 shows the assembled fitting ready for fixing up to a door against which it is standing, the inside or non-handle side being shown. There is a coiled spring in the drum seen at the top and on which the cable works. The cable is of steel wire, and the ends are fixed to the knob seen inserted in the slotted plate; this plate is in turn fixed to the bottom channel on the glass. The reference letters in this figure show a slotted plate (3), a small plate (4) attached to the rail, and the ring and screw, 28 and 44 respectively. Fig. 96 shows the slotted plate (37) fixed on the glass and the method of testing for accuracy, so that the points are in similar positions. Fig. 97 shows the top part of the fitting, handle outwards, fixed to the door. In this figure the references are—screws *a* holding plate 3, screws *b* holding main plate and handle 39; 0 indicates a setting mark on the cable wheel. Fig. 98 shows the door prepared for the fitting and one method of covering it up for easy attention. Fig. 99 gives further details of the construction of the fitting and method of adjusting the tension on the cable, for which purpose the bottom pulley bolt is fitted into a slot. Fig. 100 shows the large grooved pulley (21) which also contains the spring for balancing purposes. The smaller pulley is indicated by 29, and this is provided with a marked aluminium disc (28) to facilitate determining the length of the cable for the distance between centres (*m*). The action is rather quicker than that of other winders illustrated.

There is another type of window operator which is

very neat and effective. This takes the form of a lever on the doors, etc., which operates a lever inside the casing. A coil spring is attached to this lever which helps to lift the window, the other end of the spring being anchored to the framing of the body or door. By an ingenious device the glass is automatically locked in any position required by means of rubber strips fixed in small channels. These grips are instantly released when the lever is moved either to raise or lower the window. The action is very rapid both up and down, it is also very easy indeed, perfectly silent, and the rigidity above mentioned prevents chattering glasses. It is suitable for quarter-lights of cabriolets because there is very little under the glass line when down. It does not lift over the fence plate.

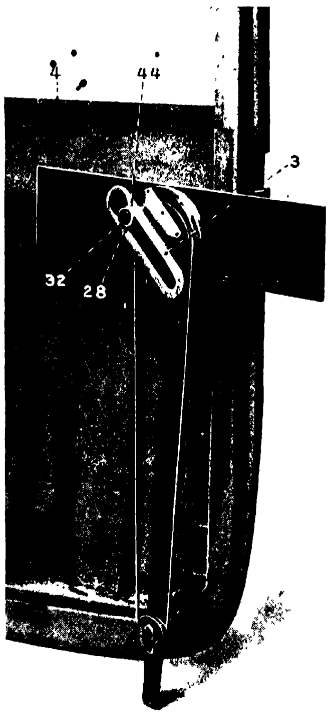


Fig. 95.—"Hera" Window Lifter.

Channels for Half-doors.—Mention has been made of channel suitable for ordinary full-length glass runs—the "Becklawat"—but there still remains the question of what may be termed half-doors—those on cabriolets and

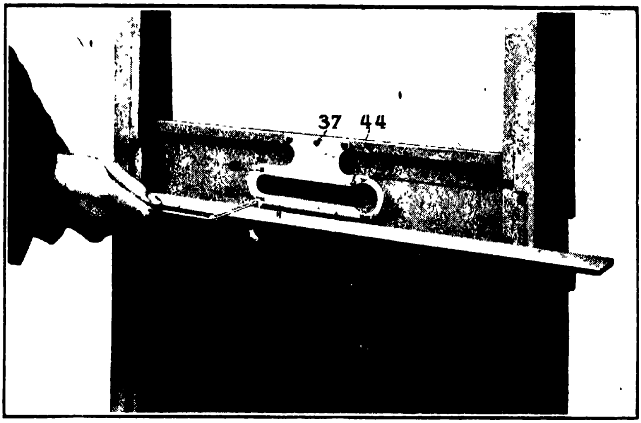


Fig. 96

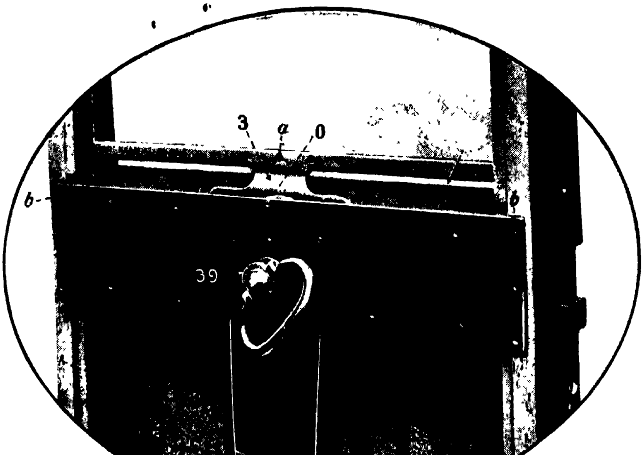


Fig. 97

Figs. 96 and 97.—Photographs showing Method of Fitting the "Hera" Window Lifter.

coupés, where the door proper finishes at the waist rail. It is necessary to provide glasses for these doors, and they must be so arranged that they will stand either all the way or part of the way up either when the doors are closed or open. The use of folding glass frame carriers adapted to frameless glasses by the insertion of "Beèklawat" may

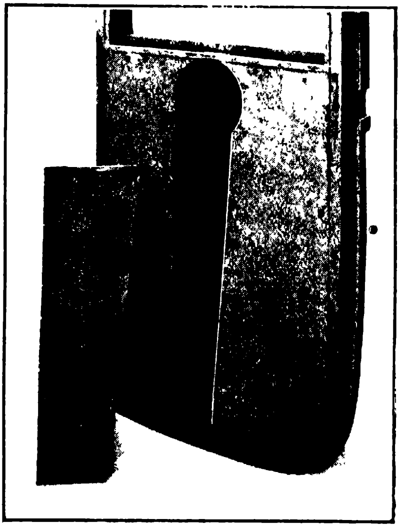


Fig. 98.—Photograph showing Lining for "Hera" Window Lifter.

meet the case, but the almost universal experience is that these are in the way of being a necessary evil. They are by no means an unqualified success whether used for frames or glasses without frames, as they are decidedly weak and wobbly even when they are most sturdily designed. The centres get worn and loose, and they require setting up to their work every time they are used. They


Fig. 99.—Photograph showing Adjustment of Cable of "Hera" Window Lifter.

so easily strain that it is quite possible for them to get such a set as to leave the glass free for the greater part of their length, and they are liable to catch the standing pillars when closing the door. It will thus be seen that something else must be used if possible. One way of meeting the case with frameless glasses is to insert tightly in the run a length of channel, and on to the glass to fix in the ordinary way another length of channel which will just move up and down in the before-mentioned fixed channel; this second channel on the sides of the glass is coupled up to the usual bottom channel with reinforcing angles at the bottom, and it provides sufficient stiffening to prevent the glasses breaking. Ordinary channel may be used provided it is dead true and a good fit, but special sets may be obtained in which the channels are dovetailed slightly, thus adding to the

hold on the run and ensuring a straight run for the glass.

Another method is to fit felt-lined channel in the runs, and to arrange for the bottom channel on the glass to pick it up at a certain point and carry it up out of the run. It is carried back again in the same way as the window is put down. Both of the above methods are preferable to the folders, as, though the section usually is lighter than with folders, they are stiffer, and they have the great advantage that when the window is down there are no unsightly fittings left outside to spoil the line of the body or rattle.

It is necessary in all cases of half-doors to provide a kind of draught piece round the pillars and cant rail; this should be of rubber tube, covered in welting leather. If this is so fixed that the glass presses evenly against it there will not be any rattle from the glasses, much as it might be expected where metal slides in

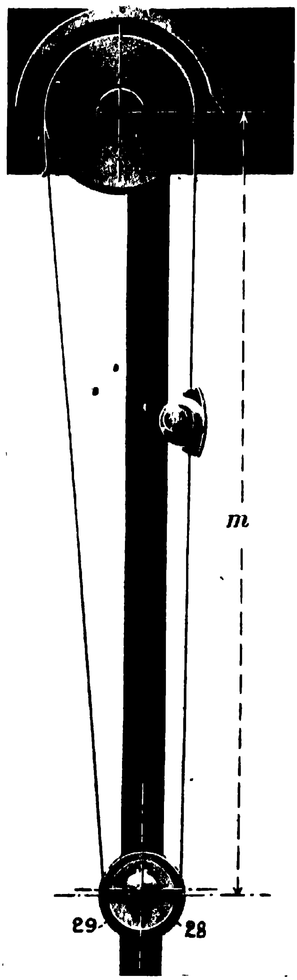


Fig. 100.—Photograph of Front Side of "Hera" Window Lifter.

metal. The tube is very necessary for frameless glasses, as the steady, yet yielding, pressure will not strain and break the glass, as would undoubtedly be the case if there was slackness.

An additional stiffening to the glass on the double channel method is provided by letting the channels go down past the glass as far as the body will allow, thus giving a footing and hold which is very useful. The glass may or may not extend to the full depth as may be desired, though, taking everything into consideration, perhaps it is preferable that it should not do so.

Fitting Glasses.— In fitting all glasses to channels or frames the use of suitable and good rubber is essential. Rubber that is of poor quality will soon perish and become hard, when it will be quite useless for the purpose it was intended to fulfil, and the consequences, at the best, will be that annoying rattles will develop. The glass should be true to gauge, as this will enable the correct thickness of rubber to be obtained, so that the glass with its packing of rubber on each side will just fit the groove.

The best method of fixing the rubber is by using good stout gold size, coating the edge and sides of the glass and also the run evenly and allowing it to get tacky. The rubber is then held in position, and the glass with the rubber is pressed firmly into the groove. The importance of having the correct gauge of rubber will be apparent as, if it is too thick, there will be great difficulty in getting it home, and if it is too thin the glass will not be silent and firm in the frame, and in either case there will be increased possibilities of the glass fracturing.

Other materials are used for packing, but rubber is the best, and gold size is the best sticking medium, as it is remarkably tenacious, and if the fit is good it does not dry

off hard. It need hardly be pointed out that the rubber must be neatly trimmed off with a sharp tool without dragging it out of the channel and distorting it, and so making the edge uneven and ragged and possibly cutting under the edge of the frame, details which all tend to detract from the smart appearance of the body.

CHAPTER XVI

Screens and Screen Fittings

THE first requirements of a windscreen are that it shall exclude draught and wet. In addition, it must be rattle-proof, easy to open and close, and be so arranged that the top half, or the top half of the part in front of the driver, must open, so that the driver can see over the lower plane and under the top plane and still keep out of the wet. Generally speaking, screens may be divided into two classes, wooden-framed and the type that are called all-metal-framed. Owing to their clumsy appearance wooden frames are very little used. The frames of metal-framed screens hardly obstruct the vision at all, and also they look smarter.

Metal frames are made up of channels of a variety of sections, each one having its special use. For some parts a plain **U**-section is used, for others an **H**-section, or a section consisting of a **U**-section with a continuation on one side. The joints are either brazed or welded, or, alternatively, made with prepared corner pieces. For both touring and closed cars, where the front seat is open, the screen is carried on forged standards; the lower-half side members of the frame in this case are made of **H**-section, one channel of which holds the glass and the other fits on to the standards. The **U**-section with one side extended is used for the bottom stile, and this helps to make a good joint with the filling-in-piece at the bottom. The top half may be made up of **U**-section and fixed to the slats which form part of the joints.

The joints for these screens are mostly fitted with a handle on the outside, and the fixing action is either an expanding one inside a fixed solid part, a contracting one on a solid stump, or by means of serrations on the head of the standard. Other adjusting devices work on, or in, the tubular member to which the top half is fixed, but whichever type is employed great care must be taken to ensure a good fit and a stiffness sufficient to withstand any

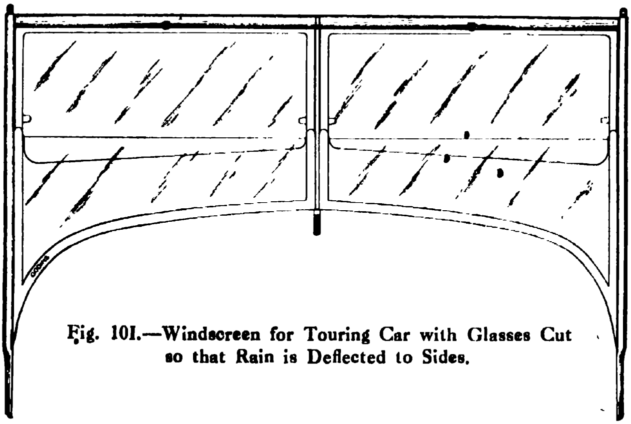


Fig. 101.—Windscreen for Touring Car with Glasses Cut so that Rain is Deflected to Sides.

tendency to distortion and the considerable vibration set up by either the engine or rough roads.

Types of Screens.—Typical screens are shown by Figs. 101 to 108 and 111 to 113. Fig. 101 shows an upright screen suitable for a touring body. It is shown shaped to suit the scuttle dash of the body as an alternative to the method of making the lower half of the screen straight and making up the shape to suit the dash panel with a piece of mahogany. It is smart, but only possible when the screen is upright; also it is much more expensive and entails more

trouble in fitting. The lower channel cannot be made to fit so neatly to the panel as wood can, unless bedded on rubber or leather with beaded or piped edges. It is shown with a vertical centre stile; this reduces the strain on the glass, as, if a body is wide and the screen is of an efficient width, the strain on a single pane of glass is very great. The top half also is in two parts, either or both of which may be opened to any angle. A silent screen, where there are two opening panes at the top, necessitates most careful

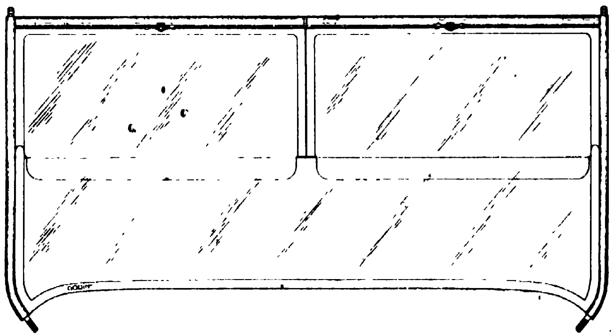


Fig. 102.—Windscreen for Touring Car with Divided Top Deflector.

work in preparing the actual hinge parts and the locking device.

If the screen is attached to a tube as shown, this tube must be a close fit on the inner tube or rod, or no matter what else is done there will be rattle and chatter. The elimination of chatter of the frames against each other and against the stile is very troublesome. A difficult condition to fulfil is that the top pane must lie over the lower one and not chatter when the car is running against a head wind on rough roads.

The screen shown by Fig. 102 is a type that is suit-

able for touring bodies and landaulettes and limousines where there is a filling-in piece at the bottom to help in fitting the screen to the dash. It will be noticed that the bottom pane is undivided. The same remarks apply to this one as to the previous one. The standards, which are shown down to the bottom of the screen only, are sometimes continued so as to find a secure fixing on the body, either by means of a flap bolted to the outside of the

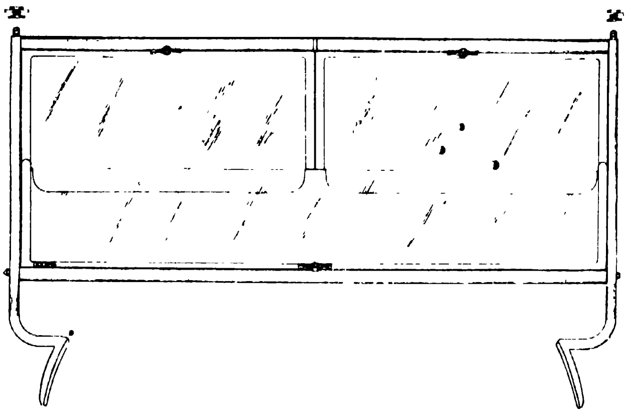


Fig. 103.—Another Divided-top Deflector Screen.

panel or by means of a bolt-like end which goes through the panel and framing and screws up on the inside to a plate which is already there as a body stiffener for the dash.

The next, Fig. 103, is generally like that shown by Fig. 102, but the lower pane will open. This type is chiefly used on touring bodies. The screen standards mentioned above are here shown prepared for fixing to the dash; the space below the bottom bar is filled in with

wood, generally down to the foot of the standard, and then shaped exactly to fit the dash panel.

The hood of a touring car is held in a catch on the top of the standards. The canopy of a closed car is bolted to the screen.

Another form of the above type is made in such a manner that instead of the lower pane moving with the fixed standards, the actual side standards are made to move with a fixed bottom pane. This type is useful for touring

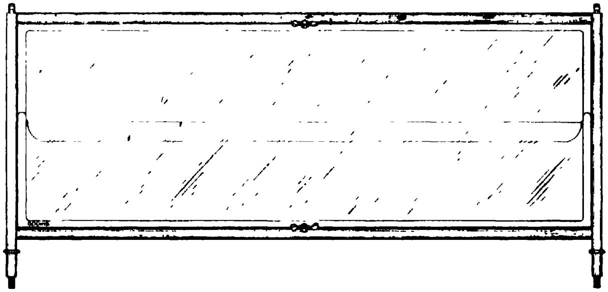


Fig. 104.—Windscreen for Touring Car with Top and Bottom Deflector.

bodies and is, of course, fitted to the dash with a wooden bar, generally known as f.i.p., which is the abbreviation for "filling-in piece." It should be pointed out that landaulettes and other fixed canopy bodies have a filling-in piece at the top as well as at the bottom. This seals up the space from the top of the screen to the underside of the roof board. It is a fixture and should fit well, being hollowed out—as is the bottom filling-in piece when the lower pane moves—to fit the tube neatly but not too tightly. It is better to give a clearance and to insert a length of round or square rubber in the centre of the groove in a tightly-fitting manner. This bears hard on the tube, but allows

it to move, and it effectively keeps wet out without grinding on the polished tube, as close-fitting wood would do. It also ensures perfect silence at these points. The standards may, with equal efficiency, be set back at an angle, the tubular bottom of the frame allowing this to rest quite well and truly at any point.

Fig. 104 shows a screen with one-piece top and bottom deflector.

On some bodies, particularly cabriolets where the

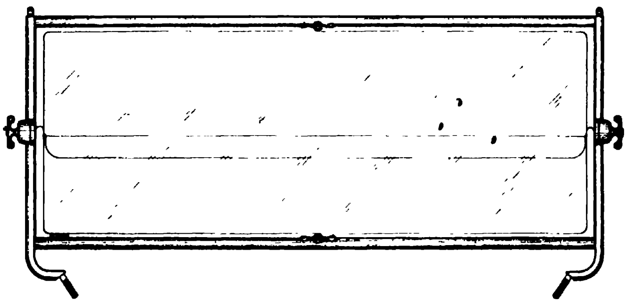


Fig. 105.—Windscreen for Touring Car, with Double Deflector and Centre Joint, Allowing Height to be Reduced.

length of canopy is a vital consideration, it is possible and highly desirable to give a set-back to the lower half of the screen and then to have the top half vertical. In addition, the top pane may, if desired, be folded down over the lower half. The folding is provided for by central joints as illustrated in Fig. 105. These joints are perfectly rigid when locked, but they allow of an easy movement of the top pane. The bottom pane may be made a fixture, or be made to fold. This type of screen may be further fitted so as to allow adjustment of the whole screen, as well as having both panes to move. This is

illustrated in Fig. 106, and it may quite easily be fitted with the centre joints shown in Fig. 105. Of course, it must be borne in mind that the addition of working parts adds to the cost, and this is often a vital consideration. The more elaborate forms of screen are mentioned to illustrate their possibilities.

Fig. 107 shows a single-pane screen suitable for some touring bodies and for two-seaters. The ends of the bottom bar are fitted to prepared ends which are fitted to

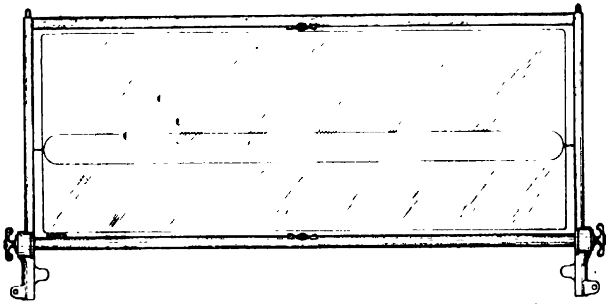


Fig. 106.—Windscreen for Touring Car, with Double Deflectors and Joint at Bottom, Allowing Angular Positions to be Altered.

and fixed on the forged standards. In common with all straight-bottomed screens this type requires a filling-in-piece.

Fig. 108 is a more elaborate screen for the same class of body as the preceding one, but instead of the filling-in-piece being of wood it is of metal, and there are glass panels inserted. In most cases these are for ornament, but in the case of bodies in which the seat is very low it is well to have them in order to make quite sure that the driver's view is not obstructed.

Two forms of top attachment for holding the hood of

touring bodies and the folding canopy of cabriolets are shown by Figs. 109 and 110. In both cases the action is the same. The spur, whether on the screen standard or on the head, enters a thimble; in one position the locking pin gives a free passage owing to the side being cut, but

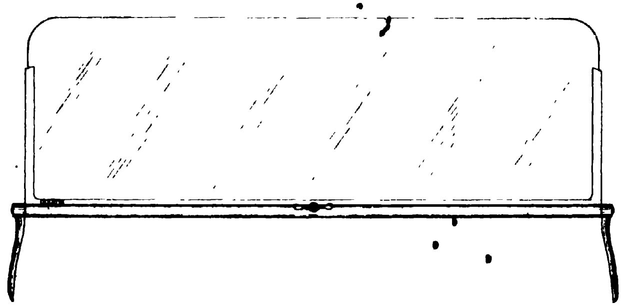


Fig. 107.—Single-deflector Windscreen.

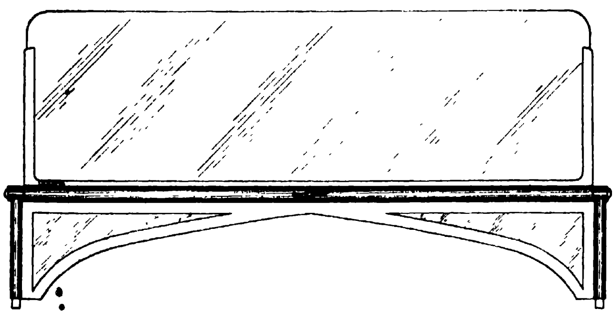


Fig. 108.—Single-deflector Windscreen with Curved Bottom Panels.

a turn of the handle moves the pin round till the full section engages in the notched spur and holds it fast.

Fitting Screens.—In setting up a screen it is important to remember that the driver must be able to see through the bottom of the lower pane and be able to see the

bonnet and wings of the car. The top of the bottom pane must be at such a height as to allow the driver to see over it. If it is of the same height as the top of the steering wheel this is usually all right, but individual requirements and fads must be dealt with sometimes. If the height of the top of the bottom pane is correct, as it will be if carefully set out as above, the bottom of the top pane when open will permit of a clear view between the edges of the two halves under any condition, and also it will not be so far open as to let water in when it is raining. In driving in the rain it is necessary that the actual opening should be sufficient to allow of the driver seeing everything.

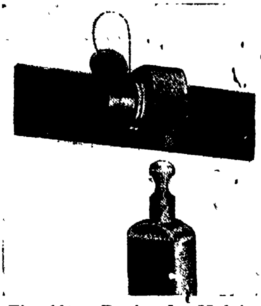


Fig. 109.—Device for Holding Hood.

The screen shown by Fig. 111 is fitted with side wings as a permanent feature.

For **V**-shaped fronts the actions may be exactly as for straight ones, and with this type the chief difficulty lies in the front standard. Typical examples are shown by Figs. 112 and 113, which are complete screens with metal centres. Another way is to make up two

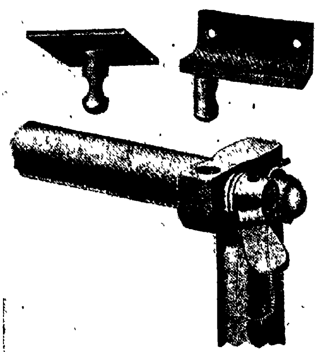


Fig. 110.—Device for Holding Canopy.

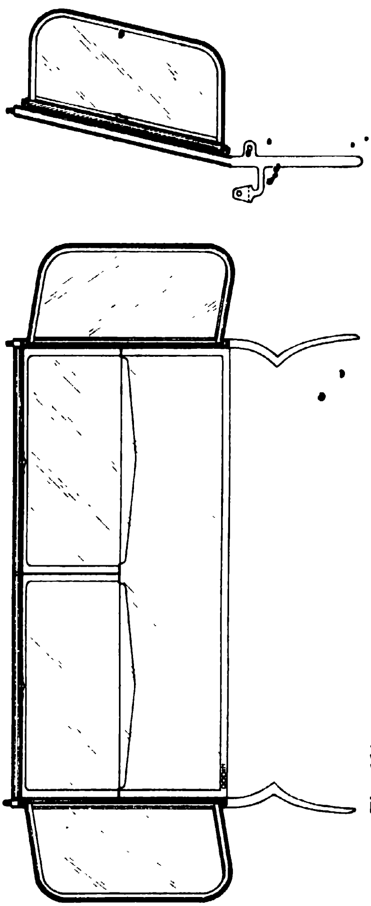


Fig. 111.—Windscreen with Fixed Top and Bottom Deflectors and Side Wings.

separate screens and fit them to a wooden pillar. Of course, the all-metal type looks lighter, but when a wooden pillar is used it is usually kept to the smallest possible dimensions and neatly rounded off on the inside.

In fixing screens to standards they may, if the standards fit into the metal frame, have screws put through the standards into the frames, and this will be found sufficient, but if there is any strain and much vibration it is better to fit neat clips round the standards and to bolt them through the frame. In securing the lower half to the body, the better way is to securely fix, by riveting or screwing and soldering on the inside, small angle pieces or, alternatively, plates and screws. These allow of a perfectly rigid fixing, which is essential if the screen is to be satisfactory.

Some types are made up with slats for fixing to the woodwork. These are screwed direct into position and are held quite rigid. There are several makers of windscreens who, on getting particulars of requirements, will prepare the fitting quite ready for fixing.

There is a special screen on the market, suitable for both straight-fronted and V-fronted bodies, which is fitted up with double panes either to the top half only or to both the bottom and top. This screen is specially designed to overcome the trouble of snow and rain getting on the screen and obscuring the vision, or necessitating the screen being open to such an extent as to let in one or the other. It is also put forward as a preventative of the large amount of back draught the occupants of the body get when the screen is open. The tendency of the air with an open screen on saloon bodies is to drive in through the opening along the roof of the body and then to return forward at a lower level, striking the passengers usually at the back

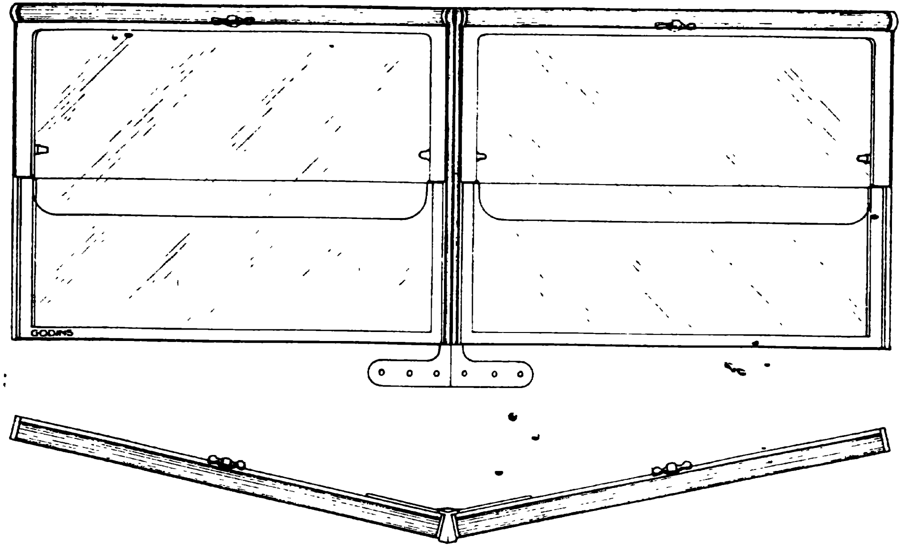


Fig. 112.—Inside-drive V-fronted Windscreen.

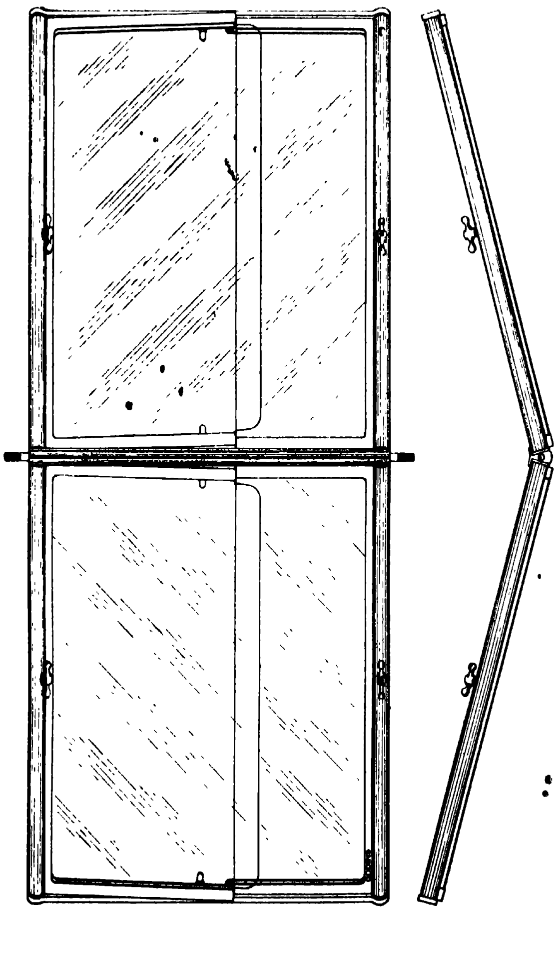


Fig. 113.—Another Inside-drive V-fronted Windscreen.

of the neck. This screen, when opened at a certain angle (outer panes outwards and inner panes inwards or vertical),

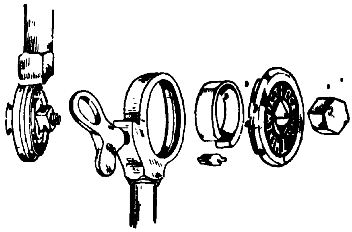


Fig. 114.—Screen Joint shown Dissembled.

causes a cushion of air to lie between the panes, which prevents the inflow of air and snow or rain.

A typical adjusting fitting dissembled is shown by Fig. 114.

CHAPTER XVII

Supplementary and Special Seats

THE provision of suitable inside seats for motor bodies is a difficult problem.

Of the prime essentials for all seats, first, of course, comes the question of comfort. To provide this calls for attention to several points. The seat must be roomy enough to provide a fair seat and be placed in such a position as to be usable. And also it must, if the smallest amount of comfort is to be obtained, be rigid; nothing is more tiring than to sit in a seat which wobbles about.

Tip-up Seats. — The simplest seats are those which simply tip up against the body when not in use and which are provided with some means of supporting them in a horizontal position when loaded. This is done on the simplest type of all—the taxicab seats—by means of the side members of the fitting which rest at the back against the brackets which are fixed to the body; they are also provided with springs which automatically tip the seat up when not in use. This seat is useful for hackney carriage work, but is by no means a suitable seat for private bodies. The very construction prevents it being anything more than "a seat"; the distance which it is possible to get it from the point of fixing to the body curtails its possibilities on the ground of comfort. The angle of seat and back is 90°, which is not good, and the fact that to occupy it at all means an awkward position, and generally facing backwards, is a drawback.

A glance at the illustration (Fig. 115) will show the bad

features of this fitting. It has perhaps only one advantage, and that is the small amount of room it takes up, combined with its automatic tipping. It should only be used for taxi bodies, or those where room is very limited and where extra passengers are only occasionally carried.

Another type of close-position seat is shown by Fig. 116. In this case, when folded away (which action is not automatic), the top of the seat forms part of the trimming of the body. The fixing is provided for in blocks of wood, generally bevelled down to lining boards on the outer edges and in which the vertical channels are fixed, usually being inserted in a groove. The illustration (Fig. 117) shows a set of fittings which are practically self-explanatory. The horizontal members carry the seat board, which in turn carries the backrest, when one is used, but it will be readily understood that comfort for occupants is not a feature of this seat. If the occupant is prepared to sit with his elbows on his knees and so avoid the uncomfortable back, he may do fairly well, but an upright position is out of the question.

These seats are generally fitted up in pairs and face backwards. If only one is fitted the possible comfort is greatly enhanced, because a sideways position is possible. Perhaps the chief recommendations for this type are that they look neat and unobtrusive and cater for a small body space.

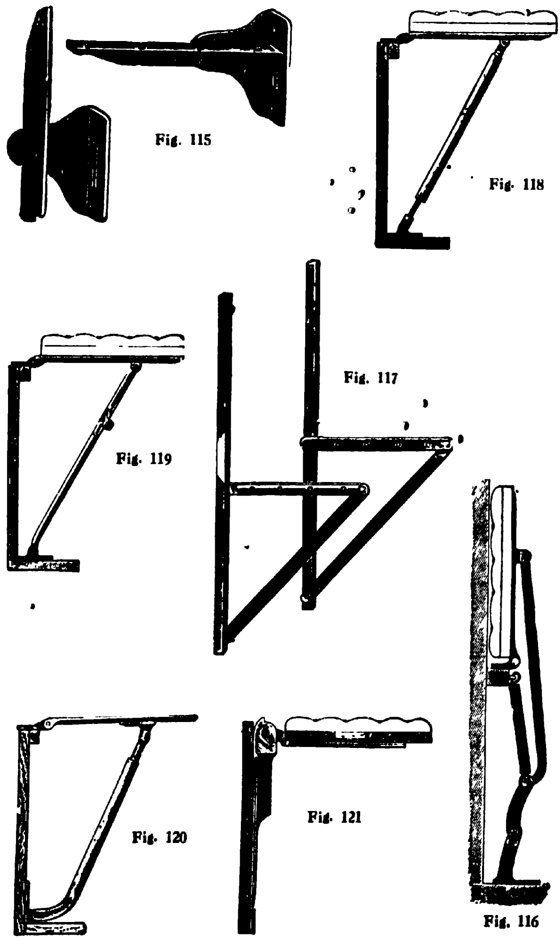
There are several other folding seats of rather uncomfortable type illustrated by Figs. 118 to 121, but they are all open to the same objections as those previously mentioned, and which cannot be overcome with any degree of success by making the seat wider from front to back, as the depth from the floor to the top of the garnish rail will not allow it.

An improved type of taxi seat is shown in Fig. 122. This gives more room for the seat and carries it out a bit farther.

Since large bodies have been built there have been attempts to provide really comfortable occasional seats. An improvement on those already dealt with are of a type fitted to a fairly long body bracket in pairs. These have a folding leg and also may have a backrest. Fig. 123 shows the seats in position and Fig. 124 the fittings only. The length of bracket puts the actual seat in a much more comfortable position, and if the backrest is placed so as to fold against the door of the body, a comfortable seat is provided with safety to the occupant, as there is no fear of falling out if the door flies open. The leg of this seat folds automatically, and is locked by means of a ball catch which secures the end of the leg when closed and releases it only on a smart pull being given; usually a handle is provided on the leg for this purpose. It is a neat, strong, rigid seat and gives the greatest possible comfort in use.

Where bodies are long enough in the quarter, or between the front of the rear cushion and the door standing pillar, a seat is put there to fold up against the side of the body when not in use. Some of these slide, others slide and revolve, but the best that can be said about most of them is that they are an "occasional" seat and nothing more. Generally, if they fold up against the side they either lie over the doorway or obstruct access to the rear seat, or if they are made to do neither to an objectionable degree, they are too small to be of much use. Nearly all of them fail in one of the essentials—rigidity.

Perhaps the very worst type of seat is that which is placed in a socket on the floor (Fig. 125). They are put



Figs. 115 to 121.—Typical Fixed Folding Seats.

forward as revolving seats, which action is provided for by their having a round peg end to fall into a socket; anything more uncomfortable it is impossible to imagine.

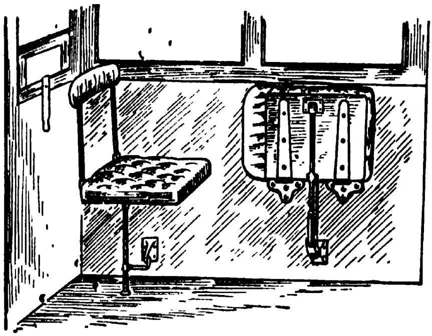


Fig. 123.—Type of Seat with Folding Leg and Back Rest.

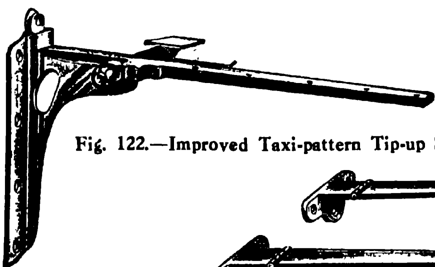


Fig. 122.—Improved Taxi-pattern Tip-up Seat.

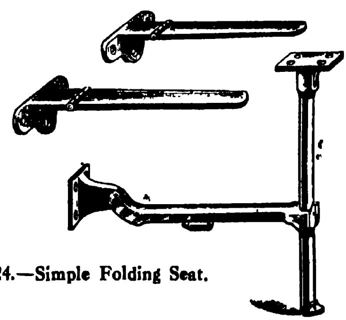


Fig. 124.—Simple Folding Seat.

The same thing applies to those seats having a revolving top.

Sliding Seats.—Regarding sliding seats, the sliding

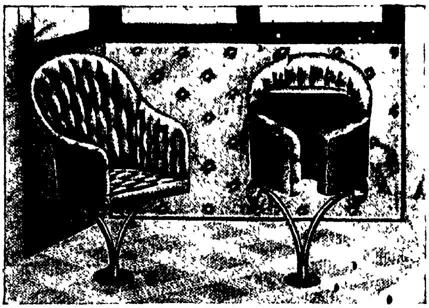


Fig. 125.—Socket-type Seats.

action, to be easy enough to allow of movement at all, allows of a certain slackness which causes involuntary movements and rattles, at the best. An example of this type is shown by Fig. 126; such construction, depending on a small sliding socket and one leg, must of necessity be wobbly.

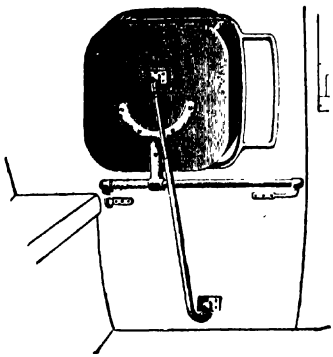


Fig. 126.—Sliding Folding Seat.

A somewhat better seat is shown by Figs. 127 and 128, which is fitted with legs that fold up; but few bodies can accommodate such a seat.

The idea of single pedestal seats, as shown by Fig.

125, is quite wrong. This is an ambitious one, but does not provide comfortable accommodation.

Arm-chair Seats.— The introduction of arm-chair seats of several types has provided a very satisfactory seat in many ways. The D'Ieteren patent seat of this type (Figs. 129 and 130) was a very distinct advance on anything previously used. It is fitted with a backrest and elbows,

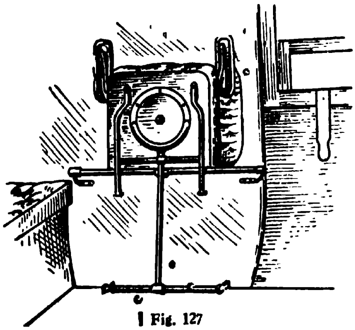


Fig. 127

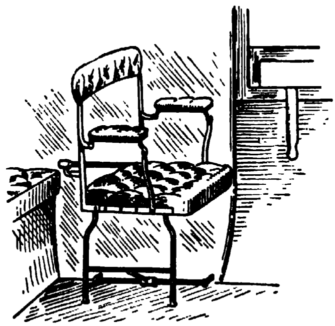


Fig. 128

Figs. 127 and 128.—Sliding Seats with Two Folding Legs.

the whole folding up neatly when not in use. The anchorage in this case is a round peg on the body side with a square against which the seat socket fits tightly to keep it rigid. The squares on the seat allow of various positions being used. An alternative method of fixing is shown by Fig. 131; the drawing (Fig. 132) shows the positions for use and carrying.

Another type of seat which is very good is an arm-chair seat with legs. This seat may be used as shown in

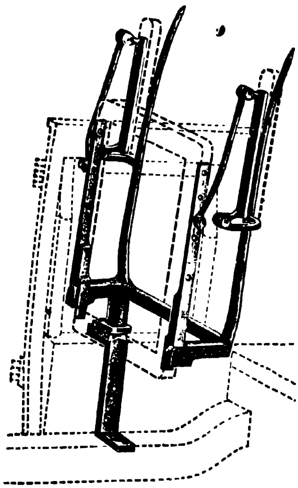


Fig. 129.—Frame of D'Ieteren Seat—Folded.

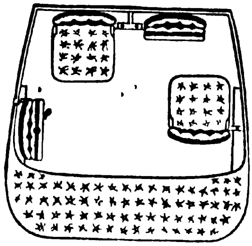


Fig. 132. -Rough Plan of Body showing Positions of Seats.

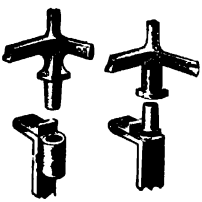


Fig. 131.—Fixing Sockets of D'Ieteren Seat

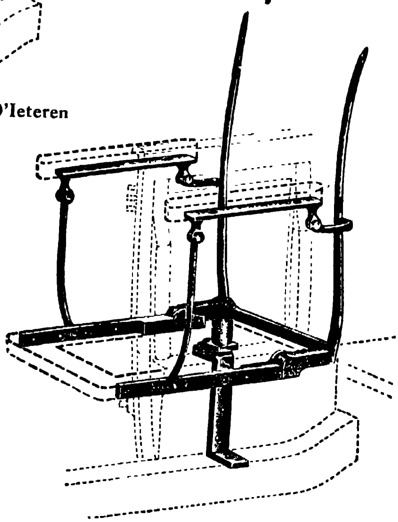


Fig. 130. -Frame of D'Ieteren Seat—Open.

Figs. 133 and 134. It may also be used outside the body if desired, as, although it is anchored when in use to a square socket on the side of the body and on the front, it may be placed on the ground outside the body and then forms a most useful chair. It may be obtained without arms if desired. To ensure rigidity the folding mechanism is locked, both when closed and open.

The stowing away of inside seats has exercised the ingenuity of many, but this side of the question need not cause much worry to anyone, as, provided the seat is comfortable, rigid and neat, and does not look too cumbersome, no real need exists to put them out of sight when not in use.

Driving Seats.—The question of driving seats for open bodies and saloon bodies has come to the fore of late years. It is agreed that the same degree of comfort and efficiency cannot be given to a five-foot driver and a six-foot driver in one and the same seat if it is a fixture.

For either, comfortable accommodation is easy, but when catering for different people it is necessary to strike a medium line.

The need for a reliable seat to suit all is apparent. It is a mistake to try too much in this direction and run away with the scheme to the extent of the inclusion of a multiplicity of movements. To be effective *and safe* there should be one movement and adjustment. The height of the seat will be governed by the steering wheel, and it will only be a question of ability to reach the pedals and levers that calls for variation in position, the pitch of the seat and backrest being definitely fixed. The old cart-type of parallel rails, with the (also old-type) adjusting device of a monkey bolt, operated by a handle and securing the seat in any position, is good. The chief drawback to this type

is the need for rails which protrude behind and in front of the medium position of the seat, and the fact that they are cumbersome and unsightly. Another adjusting arrangement for seats fitted to these rails is by means of

Fig. 133.—An Interior View showing Arm-chair Seats Fitted.

a spring-latch fastening which engages in holes on the floor.

A very good type of adjustable seat is that in which there is a pedestal in the form of a box on the floor, prepared with grooves to take a seat board fitted with tongues

to engage in these grooves. The tongues and grooves are reinforced by brass liners for strength and to prevent wear, and the seat is moved along backwards or forwards by means of a screw housed in the above-mentioned pedestal box and working in a nut fixed to the seat board. The

Fig. 134.—Another View showing Arm-chair Seats.

movement is made either by means of a small handle or a large fly nut. It is rapid enough for the purpose, and at whatever position the seat is left in, it is absolutely rigid. This type of fitting is simple to make and fit up, and is suitable for single or double seats.

Supplementary and Special Seats

The question of seats for the front of saloon bodies is one which has received a lot of attention. Many kinds have been introduced, but when it is realised that they must be very easy to open down and fold up, and that when folded up they must not be in the way, it will be understood that conditions are exacting. One way of meeting the case is to have a folding seat fixed to the side of the body, but this has its drawbacks, one of which is that the dimensions to allow it to fold restrict the thickness of the cushion; also the seat is kept tucked too close to the side. If the body is wide enough it may perhaps be possible to get a fixed seat on the body side and leave enough room to pass between, but an attempt to do this with many cars forces the driving seat too far to the right and out of line with the steering wheel, and the legs of the driver lie across the levers.

A folding seat fixed to the sliding driver's seat meets most cases. It is possible to get a good thick cushion on and an easy backrest which folds up against the bucket seat and gives easy access to both; also the folding seat is very easy to open and close. It is fitted with an automatic leg which acts as a handle to pull to open the seat. By getting the connecting rod centres out of line the seat is locked up when closed. This seat travels with the driving seat and provides comfortable accommodation for the passenger, being better for conversation than if the driving seat were in front or behind it.

A very comfortable seat is shown in Fig. 135. This is shown as fittings only, closed up; the parallel irons marked B carry the seat board, and the backrest is shown marked A. It cannot, however, be folded away when not in use, it being only intended to give access either to the rear of a body having a front door or to the

front seats of a body having a centre door, as shown in the small view, Fig. 135A. The movement is remarkably easy, and the seat when down is equal to the best type of fixed seat.

Centre Seats.—The problem which is the hardest to

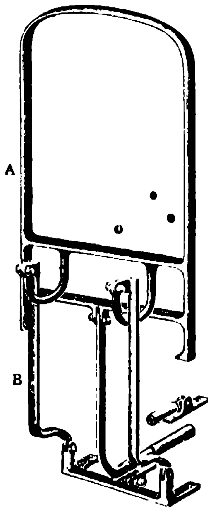


Fig. 135. — Frame of Front Folding Seat.

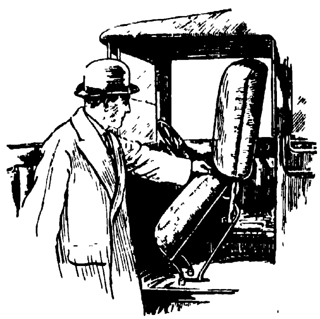


Fig. 135A.—Sketch showing Front Folding Seat in Use.

solve is to find centre seats for large saloon bodies. The arm-chair seats discussed earlier could be used if they could be carried, but to carry them on the door standing pillar is quite out of the question, as they would obstruct either the doorway or the rear seat, or most likely both.

Detachable seats to fit into sockets on the floor and

fold up neatly when not in use are also out of the question, as they are too rickety to be comfortable.

Perhaps the best solution to the problem is found in a combination seat or a pair of seats which are fixed to the floor of the body on strong pedestals or posts. The seats

Fig. 136.—Table Seats for Saloons (two seats).

are fitted with automatic folding legs and folding backrests. The back of the seat is boarded up, and the boards on each seat come together and form a table in the centre of the body. It is quite small when folded up, allowing easy movement in the body, and provides a

handy place to lay small things, or it may be used as a small luncheon table. The seats when open give ample room to sit facing forward, backward, or towards the centre of the body, and incidentally either seat may be

Fig. 137.—Table Seats Opened Out.

used and the other one left standing as a table. This seat is illustrated by Figs. 136 and 137.

These photographs show the set of seats in a saloon in various positions, and will be noted as follows: Fig. 136 shows the driver's seat and folding seat by the side folded down for use, the folding seats in the centre of the

body being closed up to form a table; the positions of cushion and folding backrest are plainly shown. Fig. 137 shows the front folding seat closed up against the side of the driver's seat, and the two centre seats opened out for occupation, incidentally illustrating the ease with which movement may be made by passengers, and roominess;

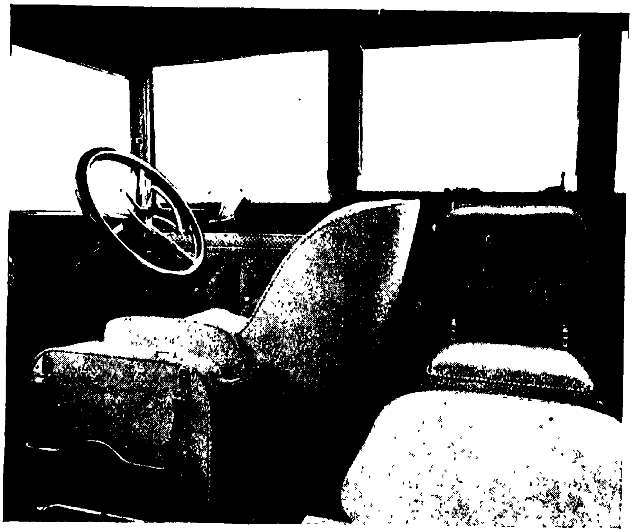


Fig. 138.—Typical Arrangement of Seats in Saloon Body.

these points are evident in Fig. 136. Fig. 138 shows a side view taken through the door, and more plainly indicates the fittings on the front folding seat. It also shows the lack of obstruction on the floor of the body at the driver's seat.

With seats having folding backrests a great improvement is made as regards comfort if the usual rod con-

necting the sides is omitted and the connection be made with leather only on to which the trimming may be fixed. By this method greater comfort is provided and space economised at the same time. The backrest hardly moves as truly as if joined, but when the seat is occupied and the weight is against the backrest, both joints find their proper position, and the easy flexible back is a decided improvement. Another form of seat by the driver's seat is shown in Fig. 139. This may be in appearance an exact

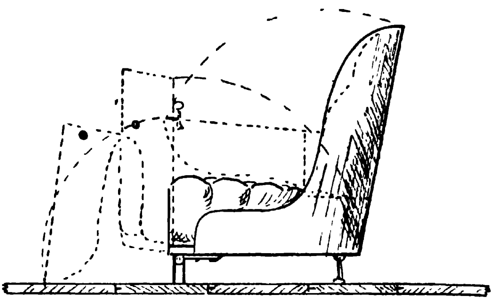


Fig. 139.—Folding Seat for Use by Side of Driver.

copy of the driver's bucket, but it is hinged underneath, revolving on a bar connecting two short legs with an automatic leg at the rear, which, by the way, should be rectangular, the bottom side taking a wide bearing on the floor. The upper part of the bucket-shaped back is hinged at the edge to allow the back to fall over when the seat is itself tipped up as shown. This seat does not give clear entry to the driver's seat, but it goes sufficiently out of the way to allow of an easy step-over, past the front edge of the fixed seat.

One very particular point must be made in relation to

all fittings for body work, and especially so with reference to seats; they must be neatly forged and machine fitted in all details which move. Accurately cut and neatly fitted joints, the rivets and bolts a good fit for the holes, and all working parts wherever possible fitted with G.M. washers, are desirable features. No one nowadays will tolerate rattling fittings in bodies.

CHAPTER XVIII

Mounting the Body on the Chassis

IF the body is carefully made, and the drawing was correct when the chassis frame was taken off the blue print, the body should fit with a fair amount of accuracy. The chassis frames are usually pretty true to the drawing, and what inaccuracies there are may be easily overcome.

Methods of Mounting.—The general practice is to bolt the bodies directly on to the frame, using holes which are provided for the purpose. Usually there are six holes, two near the front, two about in the centre of the body space, and two at the rear end. If the body is a good fit and made true the doors should work correctly and need no adjustment. Should they be found to nip when bolted down it means that small adjustment is required generally in the way of packing in or about the centre to ease the strain which is drawing the pillars out of truth. If the back of the body is pulled down, opening the doorway, it naturally follows that the body requires packing at the rear. If the frame happens to be a bit twisted the work is complicated, as it is somewhat difficult to correct such an error.

In some cases the chassis frame is liberally studded on the top with bolt or rivet heads. In cases of this sort the best way is to cut a strip of hard wood to the shape of the frame, parallel in thickness and of the same width as the top flange of the frame, and all these projections are sunk into this strip, the body being laid directly on

it, thus saving the awkward job of marking each head on the bottom framing and gouging out the holes to suit.

In fitting up the body round the gear levers and gate great care must be taken to do this as neatly as possible, making the cut as good a fit as can be got into position; probably nothing looks worse than an unsightly gaping hole round this part. Whilst seeing that it is a good fit, great care should be taken to see that the levers have absolute freedom to travel as required. The brake lever is generally quite easy to deal with, but the gear lever may be trapped and fail to get home, especially in the reverse position. Matters should be so arranged that the quadrant is accessible for removal at any time; it should not be built round so that the body has to be cut to get the levers out should occasion demand. If the levers come inside the bottom edge of the body, as they do sometimes, it is better to fit a removable block outside and finish it off so that it looks neat and workmanlike. A piece of ordinary door lapping fixed to the ends of the block makes the best finish. In many cases, however, it will be found that the actual door bottom point on the turn-under just comes right for width and allows the gate or box to come outside below the door bottom, and inside above the door bottom.

Insulation. — Insulation is an important matter. Materials such as rubber, felt, lino and leather are used, and the chief consideration is durability. It is no use putting in stuff which will, either by pressure or vibration, fret away or lose its shape too readily. Rubber of good quality is perhaps the best material for the purpose, but the efficiency of any thin strip is bound to be very low. A noisy engine will transmit its noise through anything and be noticeable with both closed and open bodies.

For the prevention of noise in a roof, the noise must

be stopped at its source, which usually is the engine. Packing the roof with cork blocks is useless. The construction of a roof does not produce the drum, it only gives expression to it.

The most perfectly insulated system is that employed by Daimlers. In this case, instead of the body being laid on and bolted to the chassis frame, the body is built upon a special frame which is designed to carry the bottom sides, which in turn carry the superstructure in the usual way. There are only four points of suspension, two at the extreme rear and two a short distance behind the dash. This, besides insulating the body very efficiently, also frees it from strain due to road shocks and distortion. The supplementary frame is very stiff and at the same time light, and besides supporting the body lengthwise it also supports it to a greater width sideways than the ordinary chassis does.

A whipping frame will ruin body work, and, fortunately, such a frame is not often met with, but the narrow chassis frames add greatly to the troubles of the body-builder.

In some cases the chassis makers definitely specify that the actual body shall be free, or partly so, allowing a bit of play at the dash. In this way some of the strains are avoided. If, however, the frame is sturdy enough to stand up to its work, there is no objection to the scuttle dash being fixed to the chassis dash. Many chassis now have a fixed dash of sturdy construction as a definite part of the whole, and to this the body is fixed. The best way, of course, is to frame up a dash to which to fix the panels, and this frame in turn is bolted to the metal dash.

In this case, if the correct line of the bonnet is taken at the top and bottom, and a correct template is made of

the chassis dash, bodies can be finished, including the scuttle dash, before being mounted. A glance at the drawing (Fig. 9) will show how it is possible to draw this and how to merge the two main lines of the side sweep at elbow and bottom into the bonnet at the point where the corner radius starts and at the bottom where it runs into the bottom line of the bonnet.

With a single body on a strange chassis it may be advisable to leave the actual scuttle dash until the body is mounted, but provided the body-maker is of fair average capability he should be able to work it up from the drawing quite correctly.

CHAPTER XIX

Ironing-up Bodies

Body Plates. — The ironing-up of bodies has not been mentioned before, but it is a necessary measure in order to relieve the strain on a body.

All closed bodies must have a good substantial body plate secured to the hardwood bottom sides, and preferably carried right across the body. This steadies the body considerably if it is carried across. The actual corner of the body plate must be well upset, and when finished be square or of an angle to suit the body; the other side of the corner should be made with a good radius, as this is where the strain comes, and is really where the pillar is weakest, as a glance at the pillars in the drawings will prove. The plate is carried about two-thirds of the way up the pillars, being gradually reduced in section as it goes up, and also neatly feather-edged off so as not to be in the way and unsightly.

The part of the body plate that goes across the body is kept square and let into the body bottom sides and cross-bar, so as to be flush with them when fixed. This plate is almost invariably fixed to the rear standing pillar. In saloons it may be necessary to fit another plate to the front standing pillar, but this does not have the same work to do as the other, and is seldom much more than a plate up the pillar and across the bottom side, either straight or bent round to increase the hold. The front doors of landaulette and similar bodies have the pillars reinforced by smaller plates, generally turned along the seat board

at the bottom and along the elbow at the top, which makes that point safe from starting with the slam of the door.

The scuttle dash is plated also, a plate fitting on to the bottom side being carried up the pillar. It is as well to carry this up past the joint of the pillar with the top rail of the dash to reinforce the joint, and then use the same plate as a sort of washer plate for the bolts or stump carrying the screen. If the screen standards are carried down outside, the bolts will be neatly countersunk in this foot, and then the inside body plate taking the bolts also makes an absolutely firm job and permits of a satisfactory screen being fitted up. This method is preferable if the screen has to stand without support at the top or, what is more trying still, if it has to help to support a hood or head extension.

For bodies having a permanently-fixed extension the feet of the screen standards may be in the form of a stump going through the dash framing; the part that comes on to the panel outside is shaped so as to give a good firm shoulder to pull down neatly on to the panel, the end of the stump being screwed and fitted to take a nut, for which the body plate forms a sound washer.

Step-Irons.—The step-irons are in most cases provided by the chassis makers, and the height from the ground or depth from the top of the frame is decided by the engineers. Usually a rule obtains that counting the total depth from the door rocker to the ground, about 3 in. is subtracted for the height of the kerb or step, and the remainder halved. The half will represent the depth from the floor of the body to the top of the landing board; 1 in. or 1½ in. is added to this, and the result is the height of the step-irons. Step-irons may be bought in the form of drop forgings either solid, angular or channel in section.

They are usually fixed to the chassis frame by two or three bolts, generally having a **T**-head with two bolts or a **T** with an extension above the iron for a third bolt. Oval section is the best, as the depth adds stiffness without undue weight.

The step or landing boards are bolted to the step-irons. Usually the front end of the board corresponds with the dash line, and the rear end comes close up to the rear wings, but both these points are subject to individual taste and ideas.

Wings. — Wings give great scope for the designer and also for the sheet metal worker, and no two body-builders get just the same effect. The appearance of the finished car may be affected very much either for better or worse according as the shape and general get-up is good or bad. The days of the flat wired and swaged wings are past in high-class work. Many designs have been tried, but the **D**-section wing, if well carried out, is the most pleasing, and if of ample dimensions and properly mounted most efficient.

In designing wings the first consideration, of course, is their possible efficiency. They must follow the tyres for a good deal of their length, though not necessarily be parallel. They must be as close to the wheels as is safe, and they must be wide enough to catch all mud thrown up by the wheels, and deep enough in section to make sure that the width is not wasted. Finally, although there is a lot of difference in ideas as to what constitutes a graceful wing, it must reach the landing board in a nice graceful sweep.

With the front wings there must be ample room for the turn of the front wheels, full lock either way being obtainable without risk of touching at any time. The

section which works up as well as any is one giving a total depth of 1¾ in. to 2 in.; the main part of the wing is shaped to a very moderate compass, and then the edges come over at about 1½ in. radius, preferably put in with a small ram's-horn curve which blends the top into the edge nicely. It is in this detail that many wings fail; the tops are good, the dimensions are good, but the turn-over of the edges is decidedly weak.

The front ends of the front wings should come just short of a vertical line from the front of the tyre. The back ends of the rear wings should be an inch or so below the wheel centre. As regards the distance outside the tyre, from 2½ in. to 3 in. is to be given, and if an equal width is given inside the tyre a fairly proportioned wing results. Care must be taken in building up the shields to the front wings that there is proper clearance for the lamps.

Fig. 140 shows flat wings in elevation and plan with a section at the wheel centres. The general appearance of the front wing also is shown. The sectional view gives the approximate shape necessary to clear the front wheel when locked. The inside shield should leave the top flat with a nice round line, flattening out as it goes down towards the frame of the chassis, generally in the manner and position indicated. The flange shown is soldered into the wing proper, as are also the inside shields after making up.

The hind wings should be a little nearer at the front than anywhere else, and to get this the best way is to take a centre ¾ in. above and ¾ in. behind the wheel centre, and with a specified clearance for a radius strike a segment of a circle forward. For the rear half take the point ¾ in. above the wheel centre, and on the wheel-centre line, and carry the arc backwards and down. The slight return

which is put on the ends for appearance sake is then put in with a suitable pattern.

The rear wing, of course, in a full-width body requires cutting to allow of it going into the wheel arch; this gives

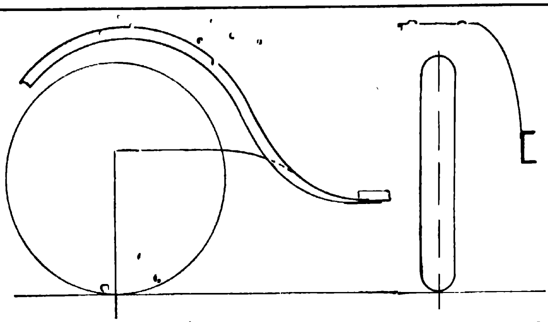


Fig. 140.—Side and Front Elevations of Front Wing with Shield.

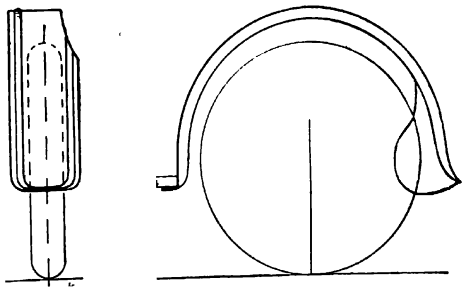


Fig. 140A.—End and Side Elevations of Rear, Rolled and Swaged Wings.

the wing a shape somewhat like that shown in the sectional view. In most cases of full-sized bodies, as distinguished from coupés, the rear end of the wing is given a shoulder-of-mutton shield, as it is called, generally on the lines of that shown in the sketch (Fig. 140A). This is

to prevent the splash from the hind wheels being sent directly on to the back of the body. The fixing of these wings is by means of an extension which is bolted under the landing board. Light-gauge metal should have a strip of iron to help to retain it securely and true to shape.

The dome section is shown in Fig. 141, but this is now almost obsolete, being too expensive for jobs which flat wings will do for and not smart enough for the best work. It sometimes is fitted with valances, as shown in Fig. 140A.

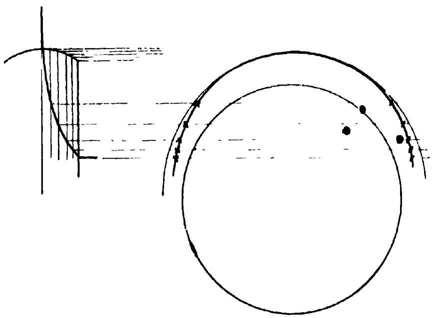


Fig. 141.—Method of Projecting Line on Body Wheel Arch to Suit Domed Wing.

The inside shield of the front wings follows generally the idea shown with the plain wings. The domed wing is decidedly difficult to fit to bodies of modern design where the wheel arch is cut right into the body. A general idea may be got of this difficulty by imagining the course the turn-under takes on the wing. With a regularly-drawn wheel arch a domed wing cannot be fitted neatly and snugly. This matter is illustrated by Fig. 141. In this, as it happens, the turn-under of the body is exactly the amount of half the wing width. The exact amount and width of the distortion from the true wing line may be

plotted by ruling lines vertically, putting both turn-under pattern and wing section as illustrated, but if a proper centre is found the wheel-arch line may be put in with almost exact results. So near, in fact, that as the wing is being cut in and fitted up a little regulation by the panel beater will make a perfect fit without distorting the wing. In the side elevation (Fig. 141) is shown the actual shape the wheel arch would be to fit the wing all the way

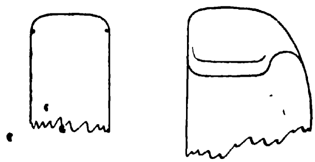


Fig. 142.—Shapes of D-section Rear and Front Wings.

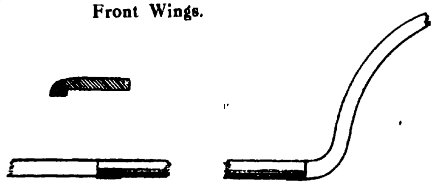


Fig. 143.—Treatment of Ends and Landing Boards.

down. The line of the apex of the dome is shown in faint lines.

To plot this wheel arch correctly draw the intended section of the wing near the side elevation generally as is shown, taking the apex of the wing from the side elevation quite correctly. Draw the wing section to the exact width and make sure that all is in order for plotting accurately, and then draw the exact turn-under to be used on the wing. Next draw any number of vertical lines

from the wing down through the turn-under line. Now produce the two points of contact of these vertical lines horizontally, the lower end right across the wing and wheel. Next, on the lower set of horizontal lines mark the distances given on the top set, counting from the apex which corresponds with the faint line. Mark these dimensions off carefully, and then, either with compasses or a curve, put in the heavy line shown which runs through all the dimension points and across the lower set of horizontal lines. On a larger scale this procedure may be carried out more elaborately.

The **D**-section wing is as set out on the sketch Fig. 142, and this shape, if properly carried out in relation to fronts of front wings and the shields of front wings, provides a very nice design. As far as possible the actual shape of the section shown should be used to finish off round the ends of the front wings. The rear ends of the front wings may be finished either to match a square-edged board or, what is much better, kept true to the section right up to the board and the board shaped to match, making up the necessary thickness of board at the front edge by adding a strip of hard wood. The rear wings may also be joined to this board in the manner indicated in Fig. 143, the front end being given a quick return sweep to bring it into line with the board.

The method of fixing the wings when this style is followed is to make a sort of box at the end of the wings and continue this under the flat of the landing board.

The shields from the body to the landing board may be carried out wide enough to enclose step heads and springs, or carried behind the springs. A ready way of fixing the shields to the frame is to bolt a strip of hard wood to the frame, thick enough to carry the shields clear of

the step heads, and then the steel shields may be screwed thereto and finished for preference on the top of the landing board, the edge being covered either by aluminium matting direct or by bright strip, which will cover up the joint of the shield and matting, the aluminium being neatly and truly turned over the step edge and finished underneath.

The mounting of wings demands very careful attention. In the first place they must be rigid and free from all rattle. Many chassis have either holes in the frame, duly reinforced, or sockets fixed to the frame ready to take the wing stays. A front wing requires two separate stays, one which is fixed a little in front of the wheel centre and the other which is fitted and fixed to the wing, about on a level with the top of the chassis frame. If bolts are used to fix the wings to the stays, it is well to make the front stay in the form of a cross, the stay proper going across the wing having two bolts through it, and the other two members of the cross along the centre of the wing having one bolt each. This method will apply to all severely plain bodies of the best class. For best work the wings are fitted up so as not to show bolts, rivets or any fixings on the top. Rivets invariably get displaced and quickly show, and countersunk bolts are as bad or worse. The way that answers better than any other is to have a supplementary stay, which is fitted with bolts to take the stay proper, and which is fixed to the wing on the edges or just past the turn of the edge and near the wired edge. The supplementary stays are made to match the shape of the wings, but not to be close to them, the ends of the stays being turned at right angles. They are fairly easy to fix up when finished, and there is no fear of damage owing to bolts or rivets being strained and breaking the

paint when being fixed. One point of attachment of the hind wing is dealt with in the same way. The fixing at the wheel arch, which the wing should fit well, is by means of screws into the framing.

To prevent dust, water, or mud, driving through the joint of the body and wing, a strip of piping, leather for preference, should be fixed in position before the wing is put up, and then the wing forced tightly to it, making a very neat finish which is highly efficient. Beaded-edge rubber strip may be used, but it looks rather poor and raw, as it must be painted before fixing, and as it stretches easily the paint breaks.

Spare Wheels.—The fitting-up of spare wheels is a very necessary item. Usually provision is made for them on the off side in a pan let into the landing board. Naturally, the position and depth of this pan is important if the wheel is held centrally. The best proposition in the way of wheel wells is the pressed steel type, which may be bought in any size. They are neatly let into the board and fixed with screws.

Frequently the wheel has to be carried very far forward, in which case it has to be let partly into the wing and perhaps into the landing board as well. In the latter case the well is made in the wing, care being taken to give ample clearance for the road wheels; the staying-up is done either at the centre of the wheel or at the tyre. Stays may be carried up from the frame with a flap end to which the wheel may be strapped up. Sometimes one is sufficient and sometimes two are required. The great thing to bear in mind is that the car is intended to travel at high speeds and under possibly bad conditions, and if the wheel is not perfectly rigid it chafes and possibly rattles. Spare wheels, rims and tyres are not ornamental

in a general way, and should be stowed as snugly as possible; also due consideration must be given to the accessibility of the engine when they are carried forward in the wings.

Luggage Grids.—The carrying of luggage is a very necessary consideration, on most cars, and in the great majority of cases the best, and often the only, place is at the rear. The grid must be of simple construction, strong and light, and it must be as inconspicuous as possible when not in use; also it must, of course, be of ample size. The stays which fix it to the chassis (which is, wherever possible, the proper place of attachment) should be quite strong enough for the purpose. The best section of metal to employ throughout is a flat section with the edge to the load. The stays must be long enough to reach to within a couple of inches of a vertical line dropped from a point about 18 in. or 20 in. above the proposed level of the grid, and here a strong forged joint with a stop should be fitted. The first half of the grid is fixed to this, as is also the guard rail which protects the back panel. The guard rail is fitted with a shoulder which rests on the fixed stays and ensures permanence of position. The width of the grid is usually the same as the chassis, though it may be wider if desired. A small locking hook is provided to keep the two halves of the grid together, and both halves, when folded up, are strapped to the guard rail. A guard rail incorporated in the grid is preferable to having rails fitted up the back panel.

Fillets.—The question of finishing fillets to the interior next demands attention. In some cases the merest finishers are used, in others a more elaborate scheme is employed. The simplest plan is for the tops of the garnish rails to be capped with polished fillets, and these may be

severely plain or machined. They make a serviceable and clean finish to the trimming, and in part hide the width of the glass runs. Whatever the shape and style employed it must be carried through in accordance with the general design of the body. Mahogany, walnut, sycamore, and many other woods are quite suitable. The fillets are polished and fixed after the body is varnished, glass string slides and lever-knob slides being afterwards fixed on them as necessary.

Handles.— Door handles are made in a variety of shapes, and should, as far as possible, harmonise with the general design. With a rotund body, and with everything carried out in a bold round style, it would not be suitable to use a ruler type, for instance. And, on the other hand, with a severely plain body ornamental handles would be out of place. The handles must be carefully fitted to the locks to ensure easy and quiet working. The handle spindles must just go home in the square in the lock. The importance of having the hole dead true in regard to the actual lock hardly needs emphasising.

Lamp Irons.— The head lamps are carried on the dumb irons either in fixed forked brackets or on adjustable brackets. The latter have much in their favour, as by releasing the fixing nuts almost any size of lamp may be fitted, and this type of iron has the advantage that they do not necessitate drilling the frame.

The side lamps may be carried on the screen standards on brackets or on the front wings. The law requires that the side lamps shall extend to the extreme width of the body.

The tail lamp must be so fixed as to illuminate the rear number plate. Cars for use abroad must be fitted to carry the lamp on the near side, which necessitates either two

lamp irons or an easily detachable one for moving to the other side as occasion demands. Great care must be taken that if a luggage grid is fixed at the rear it does not obstruct the number plate and the tail lamp. Generally it is possible to arrange matters so that the grid is high enough, but if by chance it obscures them a supplementary number plate and lamp iron fixed to the grid are necessary.

Rails.—Roof rails are possible on nearly all landaulettes and limousines. These should be as neat and smart as possible. On ¾-landaulettes they are better if fixed over the doorway and about as far in front of the front pillar as behind it. A height of 4 in. is sufficient in most cases. Care must be taken to get suitable feet to the standards and to have them suitably fixed on what is, with the exception of a light roof board, a mere skeleton. The appearance of a roof rail is enhanced by the use of plated scroll ends at the front. In all cases the roof requires protection from damage, and slats should be fixed on it close enough together to prevent boxes, etc., digging into the roof covering. For small parcels netting is necessary, but if this can be omitted the job looks smarter.

A neat folding step may be provided on the body side. It should be inconspicuous when folded up and strong enough to carry a heavy man with a load. The correct place for it is on the offside front door standing pillar, at a suitable height to allow the roof to be reached easily.

Communication Devices.—The simplest method of communicating with the driver is to have a Hall's patent flap in the window behind the driver. This is easy to open, is absolutely rigid and silent, and is very inconspicuous. It entails the occupant leaving the seat to speak, however, and on a bumpy road this is not pleasant. The

position of the flap should be as near as possible to the driver's ear.

The old-fashioned speaking-tube is very little used now. With this the front of the body is fitted with a metal trumpet adjustable to height, and this is connected by means of a flexible tube with the rear seat of the body. Here a bulb whistle is fixed, and on the whistle giving notice to the driver the occupant of the body speaks into a mouthpiece.

The latest means of communication between the occupants of the interior and the driver is an electrical appliance named the "Dictagraph." This has a speaking trumpet outside the main body, and communication is made by pressing one of two buttons on a fitting inside the body. This causes a buzzer to sound and attracts the attention of the driver, when the person inside speaks in an ordinary tone of voice without moving, and if the instrument is in good order the message is perfectly audible. Two types are made, one for fitting into new bodies and the other for existing bodies.

Landing Boards. — In most cases landing boards are kept square-edged on the front. They may be covered with either aluminium sheet, fluted, figured, or pyramid in finish, and the edges finished off with brass, nickel or polished aluminium angle and strip, either plain or fluted. Rubber, with a fluted or pyramid pattern, may also be used, as may a special material called Lin-rubber; or plain lino may be employed, but its use is generally confined to cheap work.

The step board may be rounded over at the front as shown in Fig. 143, in which case the aluminium covering is carried over the front and fixed underneath. This method does not require any angle on the front edge. The

steps may be finished in any of the aforementioned ways and materials, or special steps may be provided at the doorways. These are desirable if the car is to be used where the roads and pavements are dirty, as they enable the persons entering the car to wipe their boots before getting in. A good type of step is a steel frame of angle section into which bars of iron have been fitted. These frames are let into the landing board, the angle of the frame forming a finisher to the step covering, and they may be either fixed or hinged. They are fitted with a sheet steel tray underneath which prevents the mud splashing up, and which is easy to wash out after boots have been scraped on the grids. If hinged, the front edge is held tight by means of a ball catch.

A cast aluminium mat of similar style is on the market. This is provided with a rubber scraper on the front edge which is adjustable to allow of keeping the edge in position after wear. Another type is made in a chequer pattern with corrugated steel strips; this is neat and useful, and does not require the under tray, as the construction effectively baffles any splashes.

Step mats of fibre are extensively used, either in metal trays or fixed directly on to the landing board.

Canopy Supports.—The fitting of plated canopy supports and commode handles on the front pillar has gone out of fashion, the latter being only used now in cases where the owner is infirm and requires an aid in mounting. The fact that bodies are much lower now than formerly also makes entry and exit easier. Canopy supports are hardly necessary, as in most cases the cant rail is continuous and fully strong enough at this point. An additional matter that renders the use of these fittings unnecessary is the fact that in many cases the pillar tops

are shaped so as to run into the cant rail with a nice neat corner, making the best possible finish.

Horns.— In fixing up warning horns accessibility is the prime consideration, and next the matters of making the button or bulb inconspicuous and safe from accidental touches and quite clear of the levers.

Boxes. — Tool boxes and accumulator boxes may be put on landing boards, but only when every other possible place is found unsuitable. The accumulators should, wherever possible, be slung in the frame, in an accessible position, of course, with loose floor boards over them. Tools may be provided for under the seats, and sometimes in a combination footstool locker inside the body. If a box is provided on the landing board care must be taken to ensure it being as watertight as possible. A good firm fence inside the shut on the box is necessary, and, if hinged on the top, as most of them are, the hinge must be covered with leather. Rubber fixed to one edge for the other edge to shut down to and compress makes the very best possible joint, though it must be kept free from grease or petrol.

CHAPTER XX

Hinges, Locks and Other Fittings

Hinges.— In the days of horse-drawn carriages all broughams, landaus and carriages of every kind which were fitted with doors had the doors hung on concealed hinges. These were generally of an almost uniform shape; the box was inserted in the standing pillar and the flap screwed on to the hinge pillar. Shallow doors, or those having a very moderate turn-under, and in which it was possible to get the lower one well down, were fitted with two only, but doors with greater depth or more turn-under were generally fitted with an outrigger hinge. This was in some cases carried down the shuts and then out to the position of the centres. The form of hinge was either two round members or two half-round members which, when the door was closed, made a neat round rod. The old type of concealed hinges is illustrated by Fig. 144.

With the advent of motor bodies concealed hinges were almost entirely superseded, their place being taken by either plain or cranked butt hinges. A plain butt is illustrated by Fig. 145; the length of flap, width of flap, and thickness are made to suit any requirement. For large doors ⅝ in. joints are generally used, for lighter ones ½ in. This hinge, as will be seen, has no stop of any kind till the flaps come practically back to back, or as near as the body will allow. Various types of stop hinges have been used, of which typical examples are shown by Figs. 146, 147, 150 and 151. Fig. 146 shows the stop action provided for by enlarging the joint beyond the usual propor-

tions. It will have been noticed that in the ordinary butts the thickness of the joint equals the two flaps. Fig. 147 shows another method of providing the stop. A reinforcing web or deep bead is cast on the flaps, and this is continued past the joint, and the ends are bevelled off to any angle

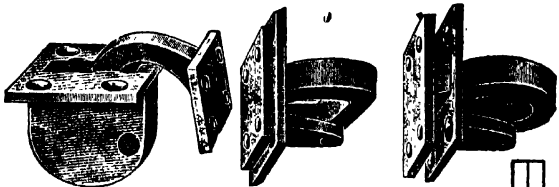


Fig. 144.—Old-type Concealed Hinges.

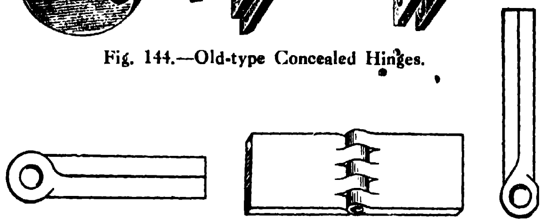


Fig. 145.—Ordinary Butt Hinges.

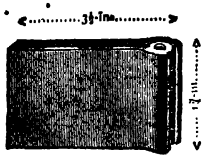


Fig. 146.—Butt Hinge with Swelled Knuckle Stop.

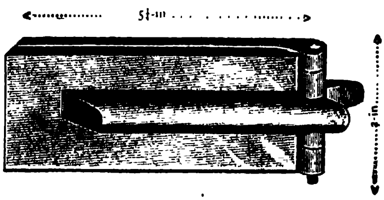


Fig. 147.—Webbed Hinge.

desired. The bead shown on Fig. 147 reinforces the flaps and gives a sturdy hinge without undue weight.

Plain hinges may be had with one or both flaps cranked, as shown in Figs. 148 to 151. The enlarged joint hinge (Fig 150) may also be obtained cranked. Note the

reinforcing of the hinge shown by Fig. 151 by the bead, which also acts as a stop.

Besides the use of the regular right-angled crank for

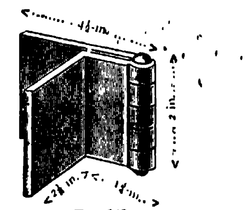


Fig. 148

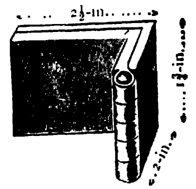


Fig. 149

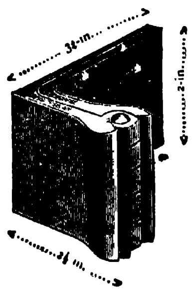


Fig. 150

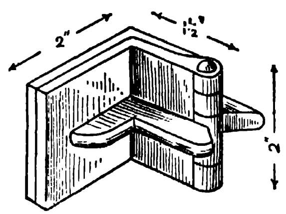


Fig. 151

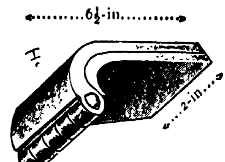


Fig. 152

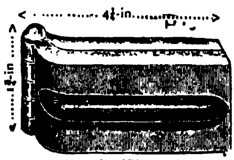


Fig. 153

Figs. 148 to 153.—Various Examples of Special Types of Hinges.

throwing back the door, a method is to bend the flaps, whether the hinge be plain as shown by Fig. 152, beaded (Fig. 153), or the stop-type.

Hinges, Locks and Other Fittings

Whatever hinges are employed, they must line exactly both ways or the door, or body, or both, will suffer through the strain imposed in opening and closing the door. The cranked hinges or bent-flap hinges are used to give greater clearance to a doorway, and are only necessary if the entry to the body is restricted by the turn-under or even by the door lying over the opening. The present severely plain designs of bodies make any projecting details appear unsightly, and so a return has been made to concealed hinges by many firms.

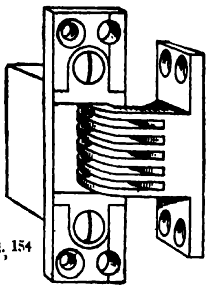


Fig. 154

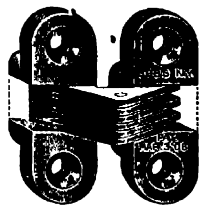


Fig. 155

Figs. 154 and 155.—Two Types of "Soss" Hinges.

In the horse-carriage days there very seldom was a light behind the door, and this simplified matters so far as concealed hinges were concerned, as it allowed of pillars being used large enough to carry them. It was frequently the practice to give a swell on the back of the pillar to allow the necessary strength where hinges were placed. Obviously, this method is impossible when there are windows behind the door, and it is a difficult problem to let in concealed hinges and provide a glass run in a normal pillar. To increase the pillar width will not do at all, as

the pillar then would appear too heavy. The matter has caused some trouble, which is fortunately met with very fair success by the use of several special hinges. The American "Soss" hinge is shown by Fig. 154. This is made in numerous sizes and can be used quite well on most types of bodies. The position has to be very carefully worked out, as the clearance for the back edge of the door and door plate is very fine. With English body work, where a fair amount of turn-under is given, the two concealed

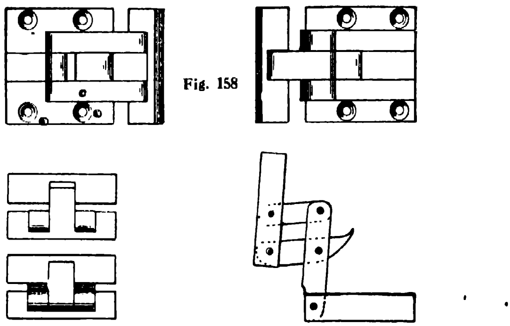


Fig. 158

Fig. 156 Fig. 157

Figs. 156 to 158.—Details of Hinge with Compound Movement.

hinges are of necessity kept high, making an outrigger near the bottom absolutely essential. Now, the fitting up of this outrigger so that it will synchronise in its movements (which are, of course, single-centred) with a double-centred hinge like the "Soss" is a trying job, particularly as the "Soss," when new, is quite stiff and tends to perform one motion or move one set of plates independently of the other movement. The length of the outrigger and its small section tend to favour the "Soss" at the risk of straining the outrigger.

Another example of the "Soss" hinge is shown by Fig. 155. This is suitable for bodies which would require a rather better clearance than a door opening at right angles with the body would give. As indicated in the illustration, it is capable of folding right back so far as the hinge itself is concerned. These hinges, in common with ordinary plain butts, require check straps.

Hinges of the pattern shown by Fig. 154 may be obtained in pairs, in which case the door flap is joined by

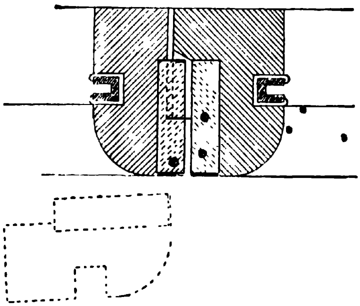


Fig. 159.—Section of Hinge Pillars showing Compound Hinge Fitted.

a strip of steel of the same section. This type is more suitable for touring bodies; the method of application enables a true alignment of the hinges to be readily attained.

Doors may be very readily removed if these hinges are used, the two screws shown in Fig. 154 being all that it is necessary to remove to enable the actual hinge to be withdrawn, leaving the waterproof box fixed to the pillar. It may be pointed out that glasses must be carefully planned for quarter-lights to allow of the case being mortised into the pillar.

An English hinge somewhat similar is shown by Figs. 156 to 159. It has a double-centred movement, and its over-

all dimensions are not prohibitive, allowing its use on normal-sized pillars. The movement is compound, and a great feature is that it requires very little more room on the pillar than an ordinary butt hinge. It has the additional advantage that it may be repaired by the insertion of new parts with ease and dispatch. As will be seen by a glance at Fig. 159, which shows the hinge open, the design allows the back edge of the pillar and door plate to clear the quarter panel with ease. As the whole hinge when closed is absolutely locked together in a solid block,

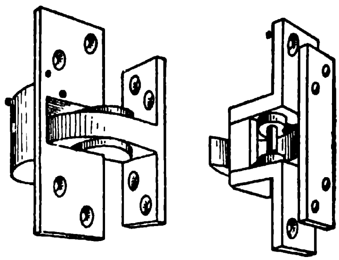


Fig. 160.—Double-centred Concealed Hinge.

there is little or no chance of vibration grinding away bearings and causing slackness. This hinge is shown in position on the pillars by Fig. 159, and this illustrates the small amount of space it takes up and also shows that it will not interfere with the glass channels.

Another English hinge having an action somewhat similar to the "Soss" is shown by Fig. 160. In this there are two definite centres, and it is very simple in construction. It has one decided advantage over the "Soss" in that it is fitted with a definite stop in the body of the hinge, and the leverage on the pillar if the door is forced open is not so great or so likely to burst out the pillar.

For pillars at the rear of the quarter-light special hinges are required, and take the form shown in Fig. 161, these being specially made for the centre pillars of cabriolets and coupés. They are usually made of gunmetal, and the centre gap is so arranged that it suits the glass run. Those made for pillars where there are glasses which lift over the fence plate must be wide enough in the gap. For frameless glasses that go straight up and down the gap need only be wide enough to take the channel, but it must be sufficiently deep to allow of this going properly home over the flaps, which run at right angles with the main hinge.

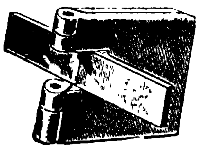


Fig. 161.—Gun-metal Centre-pillar Hinge with Run Flaps.

Fig. 162

Fig. 163

Figs. 162 and 163. -Front Pillar Hinges.

These flaps are an absolute necessity for all hinges of this kind. The main body of the hinge is usually large enough to cap the bottom of the falling pillar and the top of the standing pillar. The only fixing for these parts is by screws into the end grain of the pillars, and this, of course, is very unsound practice, and the flaps which go down the runs greatly reinforce the main fixing; if they are well and truly fixed down the runs they prevent the initial movement of the end grain screws to a great extent.

Fig. 161 shows this type with riveted centres, but they are much better and far more convenient for fitting up, in case a bit of easing out is necessary, if they are fitted with

screws, as many actually are now. The hinges are made of the correct overall width and gap for most jobs.

The front-falling pillars which are fitted on ¾-cabriolets require another special hinge, and this is illustrated by two examples (Figs. 162 and 163). These are designed to throw the pillar down neatly and closely to the standing pillar, of which the falling portion is an extension. They are fixed in the pillars with the face level with the run, and must be very rigidly secured. The sturdily reinforced centres on these hinges is an absolute necessity, as the work they are called upon to do is very severe; incidentally, a

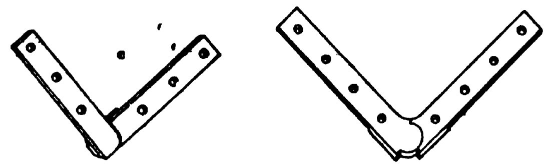


Fig. 164 Fig. 165

Figs. 164 and 165.—Cant-rail Hinges.

well-made single-ward hinge, such as is illustrated, is to be preferred to a multiple-ward example.

The ordinary cant-rail hinge is almost a thing of the past, but it may occasionally prove useful for other purposes than that for which it was originally designed and made. Figs. 164 and 165 show two examples which are practically self-explanatory. The first one is quite serviceable and strong, having a simple stopping action at the open and closed position; the second figure shows a more elaborately-made article for the same use and purpose.

For swinging pillars or places where it is necessary to provide against side play the hinge should be of the centre-

ward type, the actual top corner of the hinge being left square and the male portion of the hinge being left as large as possible, with the necessary corner removed only. The actual corner above mentioned is then fitted with a fixed distance-piece, and through the corner a screw is fixed to give greater rigidity to the whole. The size and

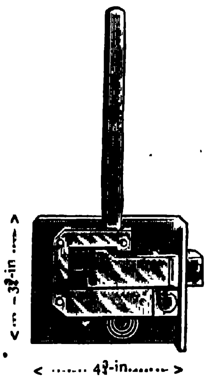


Fig. 166

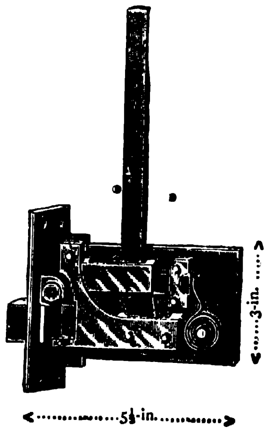


Fig. 167

Figs. 166 and 167.—Examples of Slam Locks.

shape of the male member enables the pillar to move 90° and still leave the centre ward engaged in the other half, and if truly made and fitted up and securely fixed this joint is ideal.

For dickey seats continuous piano-hinge is used, being neater and much more efficient than a series of butt hinges; this is made of a special pattern with a view to excluding water.

Locks.—With reference to locks, there is an infinite variety of these to choose from. The type which finds great favour for large doors is the "Schmidt" pattern (Fig. 166), which is made in various sizes, the largest size being most suitable for full-sized bodies. The bolt is of substantial size, ensuring the greatest possible durability both of bolt and striking plate. The face plate down the pillar

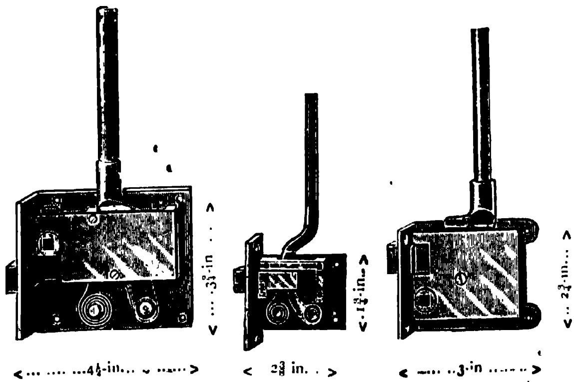


Fig. 168 Fig. 169 Fig. 170

Figs. 168 to 170.—Other Examples of Slam Locks.

on this lock, in common with all locks, may with great advantage be considerably longer than as shown in the illustration (Fig. 166). The letting in of the lock and the hole for the handle considerably weakens the pillar, and a stout plate as an extension of the shut-flange of the lock case will greatly strengthen this part. This lock may be operated by either a top lever or an inside handle, the top lever usually being preferred.

All locks are of the type known as "slam" locks as far

as doors are concerned. The only way to get a well-fitted lock to operate properly is to slam the door to, not roughly, of course, but without turning the handle. Fig. 167 shows another useful lock.

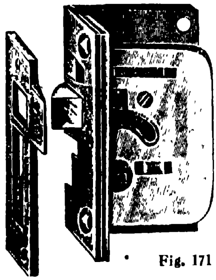


Fig. 171

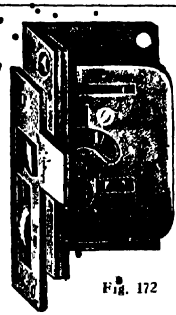


Fig. 172

Figs. 171 and 172.—Automatic Double-action Lock.

The locks for the doors of open bodies and the front seats of closed bodies may be of various types, either to be

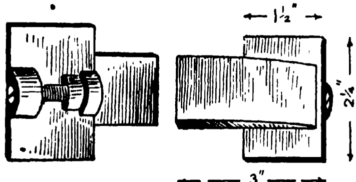


Fig. 173.—Striking Plate.

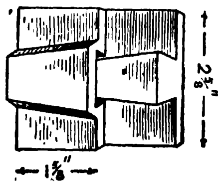


Fig. 174.—Solid Steel Dovetail.

let into the doors or fixed on over the trimming. If they are let in they may have either inside handles or top levers, and also outside handles if desired, though this last is unusual. Three types of these locks are shown by Figs.

168, 169, and 170. A type of lock which is specially designed to give safety against the accidental opening of a door is shown by Figs. 171 and 172. This lock has a double action, one automatic in closing and the other requiring a turn of the handle. It is very safe, but the same results are achieved by using a double striking plate. These striking plates are on the same principle as those used on railway coaches.

A type of striking plate designed to take up wear and slackness is shown by Fig. 173, the illustration being self-explanatory.

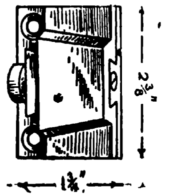


Fig. 175

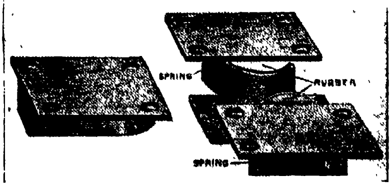


Fig. 176

Figs. 175 and 176.—Two Types of Dovetails.

Dovetails, for the purpose of holding the door tight, require very careful fitting or they are worse than useless. If there is any play they rattle abominably, making more noise than the door could do without them. It will be readily understood that their fitting is not easy. They may be of steel, as shown in Fig. 174, and the size should be ample to give a good hold and prevent chatter and wear. Removal for the purpose of adjustment disturbs the paint work very considerably, and to avoid this a dovetail has been designed on which the male portion is adjustable, as is shown by Fig. 175.

Another type is shown by Fig. 176, in which springs

encasing rubber studs grip the male member. A still more modern type is one in which the pillar portion is in the form of a round rubber stud set in a fitting to reinforce the non-effective side. The door is fitted with a semi-circular piece of steel which engages on the above-mentioned stud and keeps the door steady and quite silent. To test for accuracy when fitting, a slip of very thin paper may be laid in the dovetail and the door closed. If the paper is very tightly pressed the job will do, but if it is not the fitting is not correct.

Opinions are divided as to the necessity of more than one to a door. If two are used they may very well be smaller than when a single one is relied upon.

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